AMERICA'S NUCLEAR SOLUTION

July 20, 2016

Mr. Mark Lombard, Director
U.S. Nuclear Regulatory Commission
Division of Spent Fuel Management
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

References: (1) Letter from J. Scott Kirk (WCS) to Mark Lombard (NRC), License Application to Construct and Operate a Consolidated Interim Storage Facility for Spent Nuclear Fuel in Andrews County, Texas, Docket 72-1050, dated April 28, 2016

(2) Letter from Mark Lombard (NRC) to Scott Kirk (WCS), Acceptance Review of Specific License Application Requesting Authorization to Construct and Operate a Consolidated Interim Storage Facility for Spent Nuclear Fuel – Supplemental Information, dated June 22, 2016

(3) Letter from J. Scott Kirk (WCS) to Mark Lombard (NRC), Supplemental Information to Support the License Application for an Interim Storage Facility for Spent Nuclear Fuel in Andrews County, Texas, Docket 72-1050, dated July 6, 2016

Subject: Supplemental Information to Support a License Application for a Consolidated Interim Storage Facility for Spent Nuclear Fuel in Andrews, Texas

Dear Mr. Lombard:

Waste Control Specialists LLC (WCS) hereby files supplemental information requested by the NRC staff on June 22, 2016 (Reference 2) to support its continued review of WCS's April 28, 2016 license application requesting authorization to construct and operate a Consolidated Interim Storage Facility for Spent Nuclear Fuel in Andrews County, Texas (Reference 1). WCS is providing responses to 54 items (52%) of the Request for Supplemental Information (RSI) in accordance with the RSI Response Schedule attached to our letter to you dated July 6, 2016 (Reference 3). The changes from the original schedule are as followed: Non-Proprietary RSI 5.6 was moved to August 31, 2016 submittal schedule, due to further calculations needed. Physical Security Plan RSIs 10 and 14 were scheduled for August 31, 2016 submittal, but were completed in this submittal. Physical Security Plan RSIs 15 and 18 were scheduled for September 30, 2016 submittal, but were completed in this submittal.

Corporate
5430 LBJ Freeway, Ste. 1700
Three Lincoln Centre
Dallas, TX 75240
972-715-9800
Fax. 972-448-1419

Facility
P.O. Box 1129
Andrews, TX 79714
888-789-2783
Fax. 432-525-8902

For clarification, WCS is requesting authorization to use only those dry cask storage systems for which the associated Safety Analysis Report (SAR) revisions and Certificate of Compliance (CoC) amendments (i.e., licensing basis documents) have already been reviewed and approved by the NRC as of the time of the Application's submittal. At present, WCS requests authorization to use only these storage systems—for which the NRC has approved the licensing bases—for interim storage of up to 5,000 Metric Tons of Uranium (MTU) of spent nuclear fuel from the 12 shutdown or decommissioned nuclear reactors located across the country. Accordingly, WCS will revise License Condition (LC) 7 and any other license conditions or Technical Specifications, as necessary, to ensure such restrictions apply.

WCS submitted an Environmental Report (ER) with its license application pursuant to 10 CFR 72.34, *Environmental Report,* and 10 CFR 51.61, *Environmental report—independent spent fuel storage installation (ISFSI) or monitored retrievable storage installation (MRS) license.* In its June 22, 2016 letter, the NRC staff also requested additional information for its review of the ER and preparation of the Environmental Impact Statement (EIS) required for this licensing action by the National Environmental Policy Act (NEPA) and 10 CFR 51.20(b)(9). As contained herein, WCS has provided the requested supplemental environmental information.

WCS is providing in Attachment 1 responses to RSIs that were completed by July 20, 2016.

Attachment 2 contains replacement pages for specific parts of SAR and ER that are suitable for public disclosure. WCS anticipates that it will prepare a consolidated updated revision to the SAR and ER containing all of these pages once the RSI responses are completed.

WCS also is providing replacement pages for specific parts of the SAR that are marked as proprietary information and protected from public disclosure in accordance with 10 CFR 2.390. An affidavit declaring the basis for withholding such information from public disclosure is provided in Attachment 2.

WCS will submit responses to the RSIs pertaining to the Physical Security Plan under separate cover, as those responses contain Safeguards Information and must be controlled in accordance with the requirements specified in 10 CFR 73.22.

WCS requests that a copy of all correspondence regarding this matter be directly emailed to my attention (skirk@valhi.net) as soon as possible after issuance. If you have any questions or need additional information, please call me at 972-450-4284.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on July 20, 2016

J. Scott Kirk

J. Scott Kirk, CHP
Vice President of Licensing and Regulatory Affairs

Waste Control Specialists LLC
RSI Response Schedule

Safety Analysis Report Non-Proprietary

	20-Jul-16	31-Aug-16	30-Sep-16	31-Oct-16
Multi-Discipline		1.1		1.2
				1.2.a
				1.2.b
General	1.1.a	4.2	1.2	4.1
	1.1.b	4.3	10.1	4.4
	1.1.c	4.5	15.1	5.4
	1.1.d	4.6	16.1	5.7
	1.1.e	4.7		7.1
	2.1	4.8		9.3
	2.2	5.1		9.7
	2.3.a	5.2		
	2.3.b	5.3		
	2.3.c	5.5		
	2.3.d	5.6*		
	7.2	6.1		
	8.2	6.2		
	8.3	6.3		
	9.1	8.1		
	9.1.a	9.2		
	9.1.b	9.4		
	9.1.c	10.3		
	9.1.d	11.1		
	9.1.e	11.2		
	9.1.f	17.1		
	9.1.g			
	9.5			
	9.6			
	9.8			
	10.2			
	10.4			
	12.1			
	12.2			
	12.3			
	12.4			
	12.5			
	12.6			
Total	**33**	**22**	**4**	**10**
Percent Complete	**48%**	**32%**	**6%**	**14%**

* RSI was schedule for the July 20, 2016 submittal, but requires additional calulations, therefore it was moved to August 31, 2016 submittal.

Environmental Report

	20-Jul-16	31-Aug-16	30-Sep-16	31-Oct-16
	18.1			
	18.2			
Total	2	0	0	0
Percent Complete	**100%**	**0%**	**0%**	**0%**

Waste Control Specialists LLC

RSI Response Schedule

Safety Analysis Report Proprietary				
	20-Jul-16	31-Aug-16	30-Sep-16	31-Oct-16
	2.1 2.2 9.2		10.1	9.1
Total	3	0	1	1
Percent Complete	**60%**	**0%**	**20%**	**20%**

Physical Security Plan				
	20-Jul-16	31-Aug-16	30-Sep-16	31-Oct-16
General	1			
Specific	1 2 9 10* 11 12 13 14* 15** 16 18** 22 23 24 25	3 5 6 7 8 17 20 21 26	4 19 27	
Total	**16**	**9**	**3**	**0**
Percent Complete	**57%**	**32%**	**11%**	**0%**

* RSI's were moved from August 31, 2016 to be included in the July 20, 2016 submittal

** RSI's were moved from September 30, 2016 submittal to be included in the July 20, 2016 submittal

Overall Totals				
	20-Jul-16	31-Aug-16	30-Sep-16	31-Oct-16
Total Number of RSIs	**54**	**31**	**8**	**11**
Percent Complete	**52%**	**30%**	**8%**	**11%**

WASTE CONTROL SPECIALISTS LLC

AFFIDAVIT

I, J. Scott Kirk, Vice President of Licensing and Regulatory Affairs at Waste Control Specialists LLC (WCS), am making the following representations that to the best of my knowledge and beliefs:

1. The following document which WCS wishes to have withheld from public disclosure is:

   The Proprietary Response to Supplemental Information 2.1 related to Seismic Hazard Analysis, Chapter D, dated July 20, 2016.

2. The information contained in the document cited in 1 above is considered confidential information pursuant to Title 10 of the Code of Federal Regulations (CFR), Part 2.390(a)(4) and is thereby protected from public disclosure by regulation.

3. Pursuant to 10 CFR 2.390, the information contained in the document cited in 1 above is protected from public disclosure by regulation because it includes correspondences and reports to the NRC which contain trade secrets or commercial information pursuant to 10 CFR 2.390(a)(4).

4. The information contained in the document cited in 1 above has not been made available to public sources by WCS, nor has WCS authorized that it be made available.

J. Scott Kirk
Vice President
Licensing and Regulatory Affairs

July 20, 2016
Date

I certify the above named person appeared before me and executed this document on this the 20th day of July 2016

Notary Public

My commission expires: 3-07-17

CYNTHIA ELEANOR CARTER
Notary Public, State of Texas
Comm. Expires 03-07-2017
Notary ID 124540060

AFFIDAVIT PURSUANT
TO 10 CFR 2.390

AREVA Inc.)
State of Maryland) SS.
County of Howard)

I, Jayant Bondre, depose and say that I am a Vice President of AREVA Inc., duly authorized to execute this affidavit, and have reviewed or caused to have reviewed the information that is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.390 of the Commission's regulations for withholding this information.

The information for which proprietary treatment is sought is listed below:

- AREVA Design Criteria Document WCS01-0101 Revision 0
- AREVA Calculation WCS0l-0500 Revision 0
- AREVA Calculation WCS0l-0502 Revision 0
- AREVA Calculation WCS0l-0503 Revision 0
- AREVA Calculation WCS0l-0505 Revision 0
- AREVA Calculation 2069-0453 Revision 0
- AREVA Spreadsheet WCS01-0502R0 - 0B.xls
- AREVA Input file P1PGR.mi
- AREVA Output file P1PGR.mo

I have personal knowledge of the criteria and procedures utilized by AREVA Inc. in designating information as a trade secret, privileged, or as confidential commercial or financial information.

Pursuant to the provisions of paragraph (b) (4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

1) The information sought to be withheld from public disclosure involves a design criteria document, calculations, a supporting spreadsheet, and input and output files, which are owned and held in confidence by AREVA Inc.

2) The information is of a type customarily held in confidence by AREVA Inc. and not customarily disclosed to the public. AREVA Inc. has a rational basis for determining the types of information customarily held in confidence by it.

3) Public disclosure of the information is likely to cause substantial harm to the competitive position of AREVA Inc. because the information consists of descriptions of the design and safety analysis of dry spent fuel storage systems, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with AREVA Inc., take marketing or other actions to improve their product's position or impair the position of AREVA Inc.' s product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.

Further the deponent sayeth not.

Jayant Bondre
Vice President, AREVA Inc.

Subscribed and sworn before me this 20th day of July, 2016.

Notary Public
My Commission Expires 10 / 16 / 19

RONDA JONES
NOTARY PUBLIC STATE OF MARYLAND
My Commission Expires October 16, 2019

NAC INTERNATIONAL

NAC INTERNATIONAL
AFFIDAVIT PURSUANT TO 10 CFR 2.390

George Carver (Affiant), VP Engineering and Licensing, of NAC International, hereinafter referred to as NAC, at 3930 East Jones Bridge Road, Norcross, Georgia 30092, being duly sworn, deposes and says that:

1. Affiant has reviewed the information described in Item 2 and is personally familiar with the trade secrets and privileged information contained therein, and is authorized to request its withholding.

2. The information to be withheld includes the following NAC Proprietary Information that is being provided in support of an upcoming Waste Control Specialists (WCS) centralized interim storage facility (CISF) site-specific license application.

   - NAC Calculation 30039-5001, "WCS ISFSI Phase I Dose Rate Evaluation", Revision 0 and data disk 1 of 1

   NAC is the owner of this information that is considered to be NAC Proprietary Information.

3. NAC makes this application for withholding of proprietary information based upon the exemption from disclosure set forth in: the Freedom of Information Act ("FOIA"); 5 USC Sec. 552(b)(4) and the Trade Secrets Act; 18 USC Sec. 1905; and NRC Regulations 10 CFR Part 9.17(a)(4), 2.390(a)(4), and 2.390(b)(1) for "trade secrets and commercial financial information obtained from a person, and privileged or confidential" (Exemption 4). The information for which exemption from disclosure is herein sought is all "confidential commercial information," and some portions may also qualify under the narrower definition of "trade secret," within the meanings assigned to those terms for purposes of FOIA Exemption 4.

4. Examples of categories of information that fit into the definition of proprietary information are:

   a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by competitors of NAC, without license from NAC, constitutes a competitive economic advantage over other companies.

   b. Information that, if used by a competitor, would reduce their expenditure of resources or improve their competitive position in the design, manufacture, shipment, installation, assurance of quality or licensing of a similar product.

   c. Information that reveals cost or price information, production capacities, budget levels or commercial strategies of NAC, its customers, or its suppliers.

   d. Information that reveals aspects of past, present or future NAC customer-funded development plans and programs of potential commercial value to NAC.

   e. Information that discloses patentable subject matter for which it may be desirable to obtain patent protection.

   The information that is sought to be withheld is considered to be proprietary for the reasons set forth in Items 4.a, 4.b, and 4.d.

5. The information to be withheld is being transmitted to the NRC in confidence.

6. The information sought to be withheld, including that compiled from many sources, is of a sort customarily held in confidence by NAC, and is, in fact, so held. This information has, to the best of my knowledge and belief, consistently been held in confidence by NAC. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements, which provide for maintenance of the information in confidence. Its initial designation as proprietary information and the subsequent steps taken to prevent its unauthorized disclosure are as set forth in Items 7 and 8 following.

7. Initial approval of proprietary treatment of a document/information is made by the Vice President, Engineering, the Project Manager, the Licensing Specialist, or the Director, Licensing – the persons most likely to know the value and sensitivity of the information in relation to industry knowledge. Access to proprietary documents within NAC is limited via "controlled distribution" to individuals on a "need to know" basis. The procedure for external release of NAC proprietary documents typically requires the approval of the Project Manager based on a review of the documents for technical content, competitive effect and accuracy of the proprietary designation. Disclosures of proprietary documents outside of NAC are limited to regulatory agencies, customers and potential customers and their agents, suppliers, licensees and contractors with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

8. NAC has invested a significant amount of time and money in the research, development, engineering and analytical costs to develop the information that is sought to be withheld as proprietary. This information is considered to be proprietary because it contains detailed descriptions of analytical approaches, methodologies, technical data and/or evaluation results not available elsewhere. The precise value of the expertise required to develop the proprietary information is difficult to quantify, but it is clearly substantial.

   Public disclosure of the information to be withheld is likely to cause substantial harm to the competitive position of NAC, as the owner of the information, and reduce or eliminate the availability of profit-making opportunities. The proprietary information is part of NAC's comprehensive spent fuel storage and transport technology base, and its commercial value extends beyond the original development cost to include the development of the expertise to determine and apply the appropriate evaluation process. The value of this proprietary information and the competitive advantage that it provides to NAC would be lost if the information were disclosed to the public. Making such information available to other parties, including competitors, without their having to make similar investments of time, labor and money would provide competitors with an unfair advantage and deprive NAC of the opportunity to seek an adequate return on its large investment.

NAC INTERNATIONAL
AFFIDAVIT PURSUANT TO 10 CFR 2.390 (continued)

STATE OF GEORGIA, COUNTY OF GWINNETT

Mr. George Carver, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated herein are true and correct to the best of his knowledge, information and belief.

Executed at Norcross, Georgia, this 20th day of July 2016.

George Carver
VP Engineering and Licensing
NAC International

Subscribed and sworn before me this 20th day of July, 2016.

Jeannie Klinetob
Notary Public

JEANNIE KLINETOB
MY COMMISSION EXPIRES
SEPT 25 2019
GWINNETT CO., GEORGIA
NOTARY PUBLIC

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-1.1.a:

Provide clear and consistent descriptions of the following:

a. The proposed CISF environmental monitoring program; CISF SAR Section 9.6.2.4 only includes a statement that the program 'will be completed by WCS'.

It is not clear that the SAR contains this information. In some instances, the information that is in the SAR does not appear to be consistent in addressing the items listed above. Programs necessary for the safe operations of the CISF, including monitoring the impacts of those operations on the public and personnel should be described in the SAR. The program descriptions should justify the adequacy of the program, or lack of need for a program if it is not needed, for CISF operations. Program descriptions should include the facility, equipment, and activity (for maintenance activities) sufficient to provide an understanding of program implementation and the activities, such as maintenance activities, to be performed.

This information is needed to determine compliance with 10 CFR 72.24, 72.28(c), 72.104, 72.122(f), and 10 CFR 20.1101.

WCS Response to RSI 1.1.a:

WCS has provided the requested information in Chapter 9, Section 9.6.2.4 of the WCS SAR.

WCS SAR Impact:

Added to Section 9.6.2.4

WCS will establish a Radiological Environmental Monitoring Program (REMP) that will demonstrate compliance with 10 CFR 72.104. Details of this program are described in Chapter 9, Section 9.6.2.

In establishing the environmental monitoring program for spent fuel storage, WCS will build upon its current monitoring program for its existing facilities. This program will include the following monitoring parameters: perimeter dosimetry (Landauer Inlight® Environmental X9 (beta/X/gamma) or equivalent), soil, and air locations. This program will be implemented by the radiation safety department in accordance with written procedures.

9.6.2.4 Environmental Monitoring

WCS will establish a Radiological Environmental Monitoring Program (REMP) that will demonstrate compliance with 10 CFR 72.104. Details of this program are described in Chapter 9, section 9.6.2.

In establishing the environmental monitoring program for spent fuel storage, WCS will build upon its current monitoring program for its existing facilities. This program will include the following monitoring parameters: perimeter dosimetry (Landauer Inlight® Environmental X9 (beta/X/gamma) or equivalent), soil, and air locations. This program will be implemented by the radiation safety department in accordance with written procedures.

9.6.3 Maximum Off-Site Annual Dose

The nearest residence in Lea County, New Mexico is approximately 4 miles from the WCS CISF at SPCS coordinate (541732.42, 6873002.59). At this distance, the computed total dose rate is 4.83E-14 mrem/hr. With continuous occupancy of 8,760 hours per year, the total dose is 4.23E-10 mrem, which is essentially zero and less than the dose from natural background radiation.

9.6.4 Liquid Releases

As described in Section 6.1.2.1, there are no radioactive liquid radioactive wastes to monitor for the WCS CISF.

9.6.5 Features to Prevent Transport of Radioactive Material to the Environment

The CISF plans to accept only welded canisters with confinement intact. WCS plans to confirm integrity of confinement upon receipt. The Radiological Environmental Monitoring Program ensure the detection of potential contamination that may be present at the CISF.

The features of the WCS site make transport of radioactive materials through an aquifer not credible. The WCS site is located in the arid Permian Basin with little precipitation and the nearest aquifer is located at a depth of 800 to 1,000 feet (243 to 305, meters) below ground surface. The WCS site is separated from that aquifer by the Dockum Formation, consisting of low permeability clays ($1X10^{-9}$cm/s).

The first potential water bearing zone is a dry transmissive unit and does not provide a transport mechanism. Monitor wells near the proposed CISF are installed in the uppermost transmissive zone and have been dry since installation in 2005 or 2008.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-1.1.b

Provide clear and consistent descriptions of the following:

b. The facility or facilities and equipment that will be available and used to perform the sampling described in Section 4.5 of the CISF SAR.

It is not clear that the SAR contains this information. In some instances, the information that is in the SAR does not appear to be consistent in addressing the items listed above. Programs necessary for the safe operations of the CISF, including monitoring the impacts of those operations on the public and personnel should be described in the SAR. The program descriptions should justify the adequacy of the program, or lack of need for a program if it is not needed, for CISF operations. Program descriptions should include the facility, equipment, and activity (for maintenance activities) sufficient to provide an understanding of program implementation and the activities, such as maintenance activities, to be performed.

This information is needed to determine compliance with 10 CFR 72.24, 72.28(c), 72.104, 72.122(f), and 10 CFR 20.1101.

WCS Response to RSI 1.1.b:

WCS has provided the requested information in Section 4.5. In addition WCS is adding a new section, Section 4.5.4 Area Monitoring.

WCS SAR Impact:

Added to WCS SAR section 4.5, 1st paragraph, last sentence:

Soil and sewage samples will be analyzed at an offsite certified laboratory. Onsite surveys will be conducted and analyzed using calibrated Canberra® gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer® Liquid Scintillation Counters, and WCS calibrated Ortec® Gamma Spectroscopy counters as needed/required OR equivalent equipment.

Added new Section 4.5.4 Area Monitoring:

Air monitoring (i.e. Low Volume air sampling or High Volume air sampling as applicable) shall be conducted for each offload. Should contamination be detected above DOT conveyance limits, proper notification shall be given to all the applicable regulatory entities.

The surveys will be performed per WCS approved procedures for direct alpha/beta/gamma/neutron measurements and removable contamination swipes. The direct measurements will be conducted using Ludlum hand held instruments models 9-3, 12-4, 78, 2360, 2241, 19, and 3 or equivalent equipment.

The swipes will be processed on WCS calibrated Canberra® gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer® Liquid Scintillation Counters, and WCS calibrated Ortec® Gamma Spectroscopy counters or equivalent equipment.

The environmental air samples will be collected using Hi-Q Low Volume (0.5 – 4 cfm) air samplers or equivalent.

The environmental dosimeter monitoring will be conducted using Landauer® Inlight® Environmental X9 (beta/X/gamma) or equivalent.

Area Dosimetry Monitoring will be conducted using Landauer® Luxel + (beta/X/gamma/neutron) or equivalent.

4.5 Analytical Sampling

No sampling is required for the safe operation of the WCS CISF or to ensure that operations are within prescribed limits. The cask system designs preclude the release of effluents generated during interim storage for normal, off-normal and accident conditions. Since the sampling is not required for nuclear safety of the WCS CISF, it is not subject to ITS. While not required, it is prudent to establish a monitoring system for surface water runoff as an additional step in the radiation control process. Since the surface water drainage paths are normally dry, it is not possible to monitor runoff in a continuous or batch mode basis. Instead, quarterly soil sampling coupled with weekly/monthly radiological surveys on the casks and storage pad will be conducted. Soil and sewage samples will be analyzed at an offsite certified laboratory. Onsite surveys will be conducted and analyzed using calibrated Canberra® gas flow proportional gross alpha/beta counters, WCS calibrated Perking & Elmer® Liquid Scintillation Counters, and WCS calibrated Ortec® gamma Spectroscopy counters as needed/required OR equivalent equipment.

There are no connections to municipal sewer systems. On-site sewage would be routed to holding tanks which are periodically pumped and sent offsite for disposal in a publically operated treatment facility. Each holding tank would be periodically sampled (prior to pumping) and analyzed for applicable radionuclides.

4.5.1 Liquid Radioactive Waste Sampling

No sampling is required for the safe operation of the WCS CISF.

4.5.2 Solid Radwaste Sampling

No sampling is required for the safe operation of the WCS CISF.

4.5.3 Gaseous Radioactive Waste Sampling

No sampling is required for the safe operation of the WCS CISF.

4.5.4 Area Air Monitoring

Air monitoring (i.e. Low Volume air sampling or High Volume air sampling as applicable) shall be conducted for each offload. Should contamination be detected above DOT conveyance limits, proper notification shall be given to all the applicable regulatory entities.

The surveys will be performed per WCS approved procedures for direct alpha/beta/gamma/neutron measurements and removable contamination swipes. The direct measurements will be conducted using Ludlum hand held instruments models 9-3, 12-4, 78, 2360, 2241, 19, and 3 or equivalent equipment.

The swipes will be processed on WCS calibrated Canberra® gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer® Liquid Scintillation Counters, and WCS calibrated Ortec® Gamma Spectroscopy counters or equivalent equipment.

The environmental air samples will be collected using Hi-Q Low Volume (0.5 – 4 cfm) air samplers or equivalent.

The environmental dosimeter monitoring will be conducted using Landauer® Inlight® Environmental X9 (beta/X/gamma) or equivalent.

Area Dosimetry Monitoring will be conducted using Landauer® Luxel + (beta/X/gamma/neutron) or equivalent.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-1.1.c

Provide clear and consistent descriptions of the following:

c. The programs listed on page 13-1 of the CISF SAR, which the SAR states 'will be adopted' as necessary

It is not clear that the SAR contains this information. In some instances, the information that is in the SAR does not appear to be consistent in addressing the items listed above. Programs necessary for the safe operations of the CISF, including monitoring the impacts of those operations on the public and personnel should be described in the SAR. The program descriptions should justify the adequacy of the program, or lack of need for a program if it is not needed, for CISF operations. Program descriptions should include the facility, equipment, and activity (for maintenance activities) sufficient to provide an understanding of program implementation and the activities, such as maintenance activities, to be performed.

This information is needed to determine compliance with 10 CFR 72.24, 72.28(c), 72.104, 72.122(f), and 10 CFR 20.1101.

WCS Response to RSI 1.1.c:

WCS has provided the requested information in Chapter 13, page 13-1 of the WCS SAR. WCS will submit its updated TRN-1.1, Training Plan, by August 31, 2016.

WCS SAR Impact:

Added to page 13-1 of the WCS SAR after the first paragraph:

WCS has provided in the CISF application the following plans as required by 10 CFR Part 72:

- The Quality Assurance Plan, "Quality Assurance Program for Consolidated Interim Spent Fuel Storage Facility and the Packaging and Transport of Radioactive Materials," QAPD-400, Revision 0 (WCS SAR Chapter 13 Section 13.8, Reference 13-2),
- The Emergency Response Plan, WCS ERP-100, Consolidated Emergency Response Plan, 4-19-2016.
- The Physical Security Plan, Safeguards Contingency Plan, and Security Training and Qualification Plan, which were provided pursuant to 10 CFR 72.24(0), 72.180, and 72.184, respectively, separately as part of the license application.

~~Programs for~~ In addition to the above requirements, WCS' ~~, such as~~ R~~r~~adiation S~~s~~afety Plan and~~,~~ E~~e~~nvironmental M~~m~~onitoring Program, ~~emergency response, QA and training,~~ are described in Chapter 9 of the WCS SAR and will be adopted or adapted ~~as necessary~~ to ensure the safe operation and maintenance of the WCS CISF under 10 CFR Part 72. ~~WCS has included in the WCS CISF License Application the following proposed plans that support the conduct of WCS CISF Operations:~~

- ~~Quality Assurance (QA) Plan~~
- ~~Training Plan,~~
- ~~Radiation Safety, Environmental Monitoring and Occupational SafetyPhysical Security Plan,~~
- ~~Safeguards Contingency Plan,~~
- ~~Physical Security Plan,~~
- ~~Security Training and Qualification Plan, and~~
- ~~Emergency Response Plan.~~

~~10 CFR 72.48 reviews will be conducted to ensure continued compliance with WCS CISF 10 CFR Part 72 license requirements. This process will result in compliant programs that implement the 10 CFR Part 72 license requirements. WCS will~~
- ~~maintain the appropriate administrative and managerial controls.~~

Add Reference: Section 13.8
The Emergency Response Plan, WCS ERP-100, Consolidated Emergency Response Plan, 4-19-2016.

13. CONDUCT OF OPERATIONS

This chapter discusses the organization for the design, fabrication, construction, testing, operation, modification and decommissioning of the Waste Control Specialists LLC (WCS) Consolidated Interim Storage Facility (CISF). Included are descriptions of organizational structure, personnel responsibilities and qualifications, interface with contractors and other outside organizations.

WCS has provided in the CISF application the following plans as required by 10 CFR Part 72:

- The Quality Assurance Plan, "Quality Assurance Program for Consolidated Interim Spent Fuel Storage Facility and Packaging and Transport of Radioactive Materials", QAPD-400, Revision 1 (WCS SAR Chapter 13 Section 13.8, Reference 13-2).
- The Emergency Response Plan, WCS ERP-100, Consolidated Emergency Response Plan, 4-19-2016.
- The Physical Security Plan, Safeguards Contingency Plan, and Security Training and Qualification Plan, which were provided pursuant to 10 CFR 72.24(0), 72.180, and 72.184, respectively, separately as part of the license application.

In addition to the above, WCS' Radiation Safety Plan and Environmental Monitoring Program, are described in Chapter 9 of the WCS SAR and will be adopted or adapted to ensure the safe operation and maintenance of the WCS CISF under 10 CFR Part 72.

The development of the WCS CISF was managed by Waste Control Specialists LLC with support from AREVA Inc. (AREVA) and NAC International. Final responsibility for construction, preoperational testing, startup and operation of the WCS CISF remains with WCS. Therefore, WCS' organization and its interfaces with outside support organizations are described herein.

13.8 References

13-1 Regulatory Guide 1.8, "Qualification and Training of Personnel for Nuclear Power Plants," Revision 3.

13-2 "Quality Assurance Program for Consolidated Interim Spent Fuel Storage Facility and the Packaging and Transport of Radioactive Materials," QAPD-400, Revision 0.

13-3 Proposed SNM-1050, WCS Interim Storage Facility Technical Specifications, Amendment 0.

13-4 The Emergency Response Plan, WCS ERP-100, Consolidated Emergency Response Plan, 4-19-2016

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-1.1.d

Provide clear and consistent descriptions of the following:

d. The minimum qualification requirements of the Radiation Safety Officer (RSO)/Director of Health and Radiation Safety

It is not clear that the SAR contains this information. In some instances, the information that is in the SAR does not appear to be consistent in addressing the items listed above. Programs necessary for the safe operations of the CISF, including monitoring the impacts of those operations on the public and personnel should be described in the SAR. The program descriptions should justify the adequacy of the program, or lack of need for a program if it is not needed, for CISF operations. Program descriptions should include the facility, equipment, and activity (for maintenance activities) sufficient to provide an understanding of program implementation and the activities, such as maintenance activities, to be performed.

This information is needed to determine compliance with 10 CFR 72.24, 72.28(c), 72.104, 72.122(f), and 10 CFR 20.1101.

WCS Response to RSI 1.1.d:

WCS has updated Chapter 13, Section 13.1.3.1.

WCS SAR Impact:

Added to SAR Section 13.1.3.1, after the 2nd paragraph:

The Radiation Safety Officer (RSO)/Director of Health and Radiation Safety reports to the Sr. VP/General Manager and is responsible for ensuring compliance to WCS' Radioactive Materials License(s) along with State and Federal regulations related to radiological safety. The Radiation Safety Officer (RSO)/Director of Health and Radiation Safety has a direct line of communication with the CEO/President.

Qualifications of the designated radiation safety officer (RSO) include as a minimum: a bachelor's degree in a physical or biological science, industrial hygiene, health physics, radiation protection, or engineering from an accredited college or university, or national certification under a nationally recognized health physics authority, or an equivalent combination of experience and training in radioactive waste processing, or in radioactive waste disposal.

The Manager of Facility Compliance reports to the VP Licensing and Regulatory Affairs and shall have, as a minimum, a Bachelor's degree (or equivalent) in an engineering, or scientific field and a minimum of five years of appropriate, responsible experience in implementing and supervising a nuclear licensing and regulatory compliance program.

The Director of Engineering reports directly to the VP Operations. The Director of Engineering qualifications include, as a minimum, a Bachelor's degree in engineering and 10 years of responsible nuclear facility experience providing engineering services and at least three (3) to five (5) years supervising an engineering department. Relevant experience in a highly regulated industry is required. The Director of Engineering shall also be a Registered Professional Engineer in the state designated to host the WCS CISF.

The Radiation Safety Officer (RSO)/Director of Health and Radiation Safety reports to the Sr. VP/General Manager and is responsible for ensuring compliance to WCS' Radioactive Material License(s), along with State and Federal regulation related to radiological safety. The RSO/Director of Health and Radiation Safety has a direct line of communication with the CEO/President

Qualification of the designated RSO include as a minimum: a bachelor's degree in a physical or biological science, industrial hygiene, health physics, radiation protection, or engineering from an accredited college or university, or national certification under a nationally recognized health physics authority, or an equivalent combination of experience and training in radioactive waste processing, or in radioactive waste disposal.

The Health and Safety Manager reports to the RSO/Director of Health and Radiation Safety and shall have, as a minimum, a Bachelor degree in Industrial, Occupational or Radiation Safety or a minimum of 60 hours of related college level study and a minimum of 4 years of experience in the field of Industrial or Occupational Safety or equivalent combination of education, training and experience.

The Facility Security Officer/Security Manager reports to the Sr. VP/GM and shall have a minimum of five years of experience in the responsible management of physical security similar to that required for the WCS CISF. Academic training may not be credited toward fulfilling this experience requirement. In accordance with 10 CFR 73.51(d)(5), members of the WCS security organization will be trained, equipped, qualified and re-qualified to perform assigned job duties in accordance with appendix B to part 73, sections I.A. (1) (a) and (b), B(I)(a), and the applicable portions of II.

The Safeguards Information Coordinator (SGI-C) reports to the Facility Security Officer/Security Manager and shall have experience in safeguards programs and physical security.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-1.1.e

Provide clear and consistent descriptions of the following:

e. The maintenance activities for systems/facility structures, systems, and components (SSCs); CISF SAR Table 1-3 just states that such activities will be done under the quality assurance (QA) program

It is not clear that the SAR contains this information. In some instances, the information that is in the SAR does not appear to be consistent in addressing the items listed above. Programs necessary for the safe operations of the CISF, including monitoring the impacts of those operations on the public and personnel should be described in the SAR. The program descriptions should justify the adequacy of the program, or lack of need for a program if it is not needed, for CISF operations. Program descriptions should include the facility, equipment, and activity (for maintenance activities) sufficient to provide an understanding of program implementation and the activities, such as maintenance activities, to be performed.

This information is needed to determine compliance with 10 CFR 72.24, 72.28(c), 72.104, 72.122(f), and 10 CFR 20.1101.

WCS Response to RSI 1.1.e:

WCS has updated Table 1-3 on page 1-21 of the SAR.

The maintenance activities for systems/facility structures, systems, and components (SSCs) important to safety are described in Section 4.6 of the WCS SAR for the transportation cask, Section 7.5.1.13 of the WCS SAR for the crane, and in accordance with WCS' corrective action program as described in the QAPD located in Appendix C of the application.

WCS SAR Impact:

Changes to Table 1-3 (attached).

Cask Handling Building, "Function" column is revised as follows:

Provide for transportation cask ~~and rail car~~ light maintenance. ~~All cask maintenance will be performed under the WCS CISF QAPD [1-2].~~

Table 1-3
WCS CISF Facilities and Functions

Facility	Function
Cask Handling Building	Receive, inspect and prepare for storage, shipments of canisterized spent nuclear fuel and GTCC waste . Prepare canisterized spent nuclear fuel and GTCC waste stored at the site for off-site transport. Provide for cask ~~and rail car~~ light maintenance. ~~All cask maintenance will be performed under the WCS CISF QAPD [1-2].~~
Storage Area	Provide location for safe storage of canisterized spent nuclear fuel and GTCC waste.
Security and Administration Building	Provide main operation center and armory for site security and emergency equipment; control personnel, rail and vehicle access to the WCS CISF facilities; and provide administrative functions related to transport, communication and tracking center/facility, training and visitor center.
Receiving Area	Location to perform DOT/NRC required inspections of arriving railcars

Table 1-3
WCS CISF Facilities and Functions

Facility	Function
Cask Handling Building	Receive, inspect and prepare for storage, shipments of canisterized spent nuclear fuel and GTCC waste . Prepare canisterized spent nuclear fuel and GTCC waste stored at the site for off-site transport. Provide for transportation cask light maintenance.
Storage Area	Provide location for safe storage of canisterized spent nuclear fuel and GTCC waste.
Security and Administration Building	Provide main operation center and armory for site security and emergency equipment; control personnel, rail and vehicle access to the WCS CISF facilities; and provide administrative functions related to transport, communication and tracking center/facility, training and visitor center.
Receiving Area	Location to perform DOT/NRC required inspections of arriving railcars

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-2.1

Provide the details of present and future projected population distributions within 5-miles of site including density, and population centers and distances from the site in accordance with the guidance, and acceptance criteria provided in NUREG-1567, Section 2.4.1.3. The acceptance criteria specified in NUREG-1567, Section 2.4, regarding the requirements of 10 CFR 72.98 and 10 CFR 72.100 covering the present and future projected population distribution information, is not addressed in WCS CISF SAR, as per the guidance provided in subsection 2.4.1.3. There is a reference to the Environmental Report (ER), Attachment A (it appears to be labelled Appendix A), covering Socioeconomic Impact Assessment including census data. There is reference of the closest population centers being Andrews, Texas and Eunice, New Mexico, and other nearby population centers in the ER. However, the application does not provide the details of population numbers for clarity and perception for the size of population. The closest population center having 25,000 or more people is identified in CISF SAR Section 2.1 to be Hobbs, NM, which is 17.5 miles northwest of the WCS CISF. Though the population seems to be less than 25,000, the cities of Andrews and Eunice are misrepresented as population centers in ER Section 1.1. The population distribution presented in the ER addressed the present and future projected population distribution for five counties (Andrews, Gaines, Winkler and Ector in Texas, and Lea in New Mexico) covering the 30-mile Region of Interest (ROI) for ER consideration. This population distribution in the ER is referenced without any summary of pertinent population distribution information by sector and direction within 5 miles of the site as required for the CISF SAR 2.1. Neither the total population within 5 miles of site nor population of nearest city nor population center to the site is presented. No summary/conclusion is presented for present and future population distribution in the region of the site. For observation, the Private Fuel Storage Facility (PFSF) FSAR Chapter 2, Section 2.1.3 may serve as an example, where the content pertaining to population distribution is presented following the guidance NUREG-1567, Section 2.4.1.3, which has been accepted by the staff for review. As such the staff considers that the information presented by the applicant pertaining to the present and future projected population data in the WCS CISF FSAR is not adequate to perform the review of this section covering the demography of the proposed site.

This information is needed to determine compliance with 10 CFR 72.98 and 10 CFR 72.100.

WCS response to RSI 2.1:

- The acceptance criteria specified in NUREG-1567, Section 2.4, regarding the requirements of 10 CFR 72.98 and 10 CFR 72.100 covering the present and future projected population distribution information, is not addressed in WCS CISF SAR, as per the guidance provided in subsection 2.4.1.3.

New figures are provided and are included in the SAR Section 2.

- There is a reference to the Environmental Report (ER), Attachment A (it appears to be labelled Appendix A), covering Socioeconomic Impact Assessment including census data.

WCS is providing the requested reference change.

- There is reference of the closest population centers being Andrews, Texas and Eunice, New Mexico, and other nearby population centers in the ER. However, the application does not provide the details of population numbers for clarity and perception for the size of population.

Requested information is contained in the WCS ER Section 2.2.1

- The closest population center having 25,000 or more people is identified in CISF SAR Section 2.1 to be Hobbs, NM, which is 17.5 miles northwest of the WCS CISF. Though the population seems to be less than 25,000, the cities of Andrews and Eunice are misrepresented as population centers in ER Section 1.1.

WCS has modified the references to Andrews and Eunice as a "population centers" to "communities" in ER Appendix A, Section 1.1, Socioeconomic Impact Assessment, and SAR Section 2.

The population distribution presented in the ER addressed the present and future projected population distribution for five counties (Andrews, Gaines, Winkler and Ector in Texas, and Lea in New Mexico) covering the 30-mile Region of Interest (ROI) for ER consideration. This population distribution in the ER is referenced without any summary of pertinent population distribution information by sector and direction within 5 miles of the site as required for the CISF SAR 2.1. Neither the total population within 5 miles of site nor population of nearest city nor population center to the site is presented. No summary/conclusion is presented for present and future population distribution in the region of the site.

WCS has provided new figures in the WCS SAR Chapter 2, Section 2, added information below.

WCS ER Appendix A Impact:

A replacement page has been provided for ER Appendix A page 1-1

WCS SAR Impact:

Change to SAR Page 2-2, paragraph 3:

The 15-mile radius area around the WCS CISF is very low population with some industry and mostly ranch land and very little seasonal variation in the population. In the Environmental Report, Appendix A ~~Attachment A~~, the Socioeconomic Impact Assessment includes the most recent Census data and Figure 1.1-1 in Appendix A~~Attachment A~~ shows cities and towns with a 30 mile radius of the WCS CISF.

Change to SAR Page 2-1, paragraph 1:

Eunice, the closest community~~population center~~, is located approximately 8 kilometers (5 miles) west at the cross-junction of New Mexico Highway 207 and 234.

Add to WCS SAR Chapter 2, Section 2.1, Page 2-3, at the end.

Population centers (more than 25,000 persons) and communities (places less than 25,000 persons) are shown below with distance from the site and 2010 census population (see **Figure 2-25**):

- Andrews, Andrews County, Texas: 32 miles southeast: 11,088 persons
- Eunice, Lea County, New Mexico: 6 miles west: 2,922 persons
- Hobbs, Lea County, New Mexico: 20 miles north; 34,122 persons
- Jal, Lea County, New Mexico: 23 miles south; 2,047 persons
- Lovington, Lea County, New Mexico: 39 miles north-northwest; 11,009 persons
- Seminole, Gaines County, Texas: 32 miles east-northeast; 6,430 persons
- Denver City, Gaines County, Texas: 40 miles north-northeast; 4,479 persons

For additional information regarding the demographics of the general project area and potential socio-economic impacts associated with the proposed WCS CISF, please refer to the Socioeconomic Impact Assessment in Appendix A of the Environmental Report.

Population within a 5-mile radius centered on the proposed WCS CISF consists of scattered residences located in the eastern portion of the City of Eunice in Lea County, New Mexico. The closest residents to the WCS CISF reside within the 20 homes located approximately 4 to 5 miles west of the project. The locations of these homes with relation to the proposed WCS CISF estimated population counts are shown in Figure 2-19 Present Population Distribution.

The estimated 2014 population within a 5-mile radius is 55 persons. This estimate assumes 20 households identified based on 2014 aerial photos superimposed with concentric one-mile radius circles. Household size was determined using an average household size of 2.71 persons according to 2010 census data for Census Tract 8/Block Group 2 in Lea County and by applying that average household size to the number of households identified. Because of the remoteness of the proposed WCS CISF and because a majority of the land within the 5-mile radius is owned by WCS, it is unlikely that the permanent population within a 5-mile radius would change significantly during the proposed license period.

No transient or institutional populations are known within 5 miles of the proposed WCS CISF. There are no known public recreation areas or state or federal parks within the 5-mile radius.

Texas State Highway 176, a two-lane highway generally oriented east-west, is the only public transportation facility that provides access to the existing WCS commercial waste management facility. Land uses within a few miles of the WCS CISF include agriculture, cattle ranching, drilling for and production from oil and gas wells, quarrying operations, uranium enrichment, municipal waste disposal, and the surface recovery and land farming of oil field wastes.

Based on U.S. Census Bureau decennial data, Lea County experienced a historical annual percentage growth rate of 0.55% from 1970 to 2010. Applying this historical annual percentage growth rate of 0.55%, the projected 2064 population within the 5-mile radius is 72 persons, an increase of 17 persons from the estimated 2014 population. Table 2.8 provides the population projection calculations for the populated sectors within a 5-mile radius of the proposed WCS CISF. This projection is conservative but appropriate given existing land uses and limited land area available for development. Figure 2.20 Projected Population Distribution illustrates the projected population distribution within the 5-mile radius based on the 0.55% annual percentage growth rate.

Table 2-8 Projected Populations Based on Annual Percentage Growth Rate of 0.55%

Sector	2014 Estimated Residences[1]	2014 Estimated Population[2]	Projected Population[3]				
			2024	2034	2044	2054	2064
WNW	2	6	6	7	7	7	8
WSW	18	49	52	55	58	61	64
	Total	**55**	**58**	**62**	**65**	**68**	**72**

Source/Note: [1]Residences were identified based on 2014 aerial photos superimposed with concentric one-mile radius circles. [2]The 2014 estimated population was calculated by applying the average household size of 2.71 persons (based on 2010 Census data representing Census Tract 8/Block Group 2 in Lea County) to the number of residences identified on 2014 aerial. [3]The following projected population calculation was utilized: $[(0.55/100)+1]^{10}$ x [(2014, 2024, 2034, 2044, or 2054) Population].

Two other possible scenarios were investigated based on 2010-2040 population projections prepared by the Geospatial and Populations Studies Group - University of New Mexico. Applying an annual percentage growth rate of 2.4 percent (based on projected Lea County Populations 2010-2040) results in a 2064 population projection of 177 persons. With a 1.2 percentage annual growth rate, which is half of the projected growth rate for Lea County (2010-2040), projected population by 2064 would be 100 persons. Tables 2-9 and 2-10 exhibit these calculations for the populated sectors within a 5-mile radius. Ultimately, these growth scenarios were deemed too aggressive given existing land uses and the limited land area available for development within populated sectors.

Table 2-9: Projected Populations Based on Annual Percentage Growth Rate of 2.4%

Sector	2014 Estimated Residences[1]	2014 Estimated Population[2]	Projected Population[3]				
			2024	2034	2044	2054	2064
WNW	2	6	8	10	12	15	19
WSW	18	49	62	78	99	125	158
Total		**55**	**70**	**88**	**111**	**140**	**177**

Source/Note: [1]Residences were identified based on 2014 aerial photos superimposed with concentric one-mile radius circles. [2]The 2014 estimated population was calculated by applying the average household size of 2.71 persons (based on 2010 Census data representing Census Tract 8/Block Group 2 in Lea County) to the number of residences identified on 2014 aerial. [3]The following projected population calculation was utilized: $[(2.4/100)+1]^{10}$ x [(2014, 2024, 2034, 2044, or 2054) Population].

Table 2-10: Projected Populations Based on Annual Percentage Growth Rate of 1.2%

Sector	2014 Estimated Residences[1]	2014 Estimated Population[2]	Projected Population[3]				
			2024	2034	2044	2054	2064
WNW	2	6	7	8	9	10	11
WSW	18	49	55	62	70	79	89
Total		**55**	**62**	**70**	**79**	**89**	**100**

Source/Note: [1]Residences were identified based on 2014 aerial photos superimposed with concentric one-mile radius circles. [2]The 2014 estimated population was calculated by applying the average household size of 2.71 persons (based on 2010 Census data representing Census Tract 8/Block Group 2 in Lea County) to the number of residences identified on 2014 aerial. [3]The following projected population calculation was utilized: $[(1.2/100)+1]^{10}$ x [(2014, 2024, 2034, 2044, or 2054) Population].

2. SITE CHARACTERISTICS

Waste Control Specialists LLC (WCS) controls approximately 14,000 acres of land in northwestern Andrews County. Within this property, WCS currently operates a commercial waste management facility on approximately 1,338 acres of land (the existing facility) and the remaining acreage is mostly undeveloped land. The WCS CISF will be located north and adjacent to the existing facility approximately 300 meters from the north edge of the rail loop as seen in Figure 2-1. The approximate coordinates for Phase I of the WCS CISF site are Latitude 32° 27' 08" north longitude 103° 03' 35" west longitude. The existing maximum and minimum elevations of the site are about 3520 feet and 3482 feet mean sea level (msl), respectively. Eunice, the closest community, is located approximately 8 kilometers (5 miles) west at the cross-junction of New Mexico Highway 207 and 234. The WCS CISF is about 51 kilometers (32 miles) northwest of Andrews, Texas, and approximately 32 kilometers (20 miles) south of Hobbs, New Mexico. The nearest population center with an international airport is Midland-Odessa, located 103 kilometers (64 miles) southeast of the proposed WCS CISF.

More generally, the WCS CISF site is located at the southwestern edge of the Southern High Plains. This part of Andrews County is a gently southeastward sloping plain with a natural slope of about 8 to 10 feet per mile. A topographic map of the area is shown in Figure 2-2.

The WCS site has two approved Resource Conservation and Recovery Act (RCRA) permits from the TCEQ (HW-50398[2-33] and HW-50397[2-32]) and a Toxic Substances Control Act (TSCA) authorization from the United States Environmental Protection Agency (EPA). WCS also possesses radioactive material license (RML) R04100[2-30] and R05807[2-31] for low-level radioactive wastes (LLRW) and byproduct material, respectively.

2.1 Geography and Demography of Site Selected

The WCS CISF is situated in northwest Andrews County on the southwestern edge of the Southern High Plains. The entire WCS site is approximately 14,000 acres with all acreage being owned by WCS. The nearest population center of 25,000 or more is Hobbs, NM about 17.5 miles northwest of the WCS CISF.

Land uses within a few miles of the WCS CISF include agriculture, cattle ranching, drilling for and production from oil and gas wells, quarrying operations, uranium enrichment, municipal waste disposal, and the surface recovery and land farming of oil field wastes. Surface quarrying of caliche, sand and gravel is conducted in New Mexico, approximately one mile west of the WCS CISF. The oil field waste recovery facility is adjacent to this quarry. The Lea County, New Mexico municipal solid waste landfill is located adjacent to the state line to the immediate south and west of the WCS CISF. Uranium Enrichment Company (URENCO) operates a centrifuge technology, uranium enrichment facility about one mile to the southwest of the HW-50397 RCRA landfill location.

The 15-mile radius area around the WCS CISF is very low population with some industry and mostly ranch land and very little seasonal variation in population. In the Environmental Report, Appendix A, The Socioeconomic Impact Assessment includes the most recent Census data and Figure 1.1-1 in Appendix A, shows cities and towns with a 30 mile radius of the WC CISF.

Except for a historical marker and picnic area approximately 5.5 km (3.3 mi) from the WCS CISF at the intersection of New Mexico Highways 234 and 18, there are no known public recreation areas or state or federal parks within 8 km (5 mi) of the WCS CISF.

The following nonindustrial water resources are located in the proposed WCS CISF vicinity:

- A manmade pond on the adjacent quarry property owned by Permian Basin Materials (Permian, 2016[2-28]).
- Baker Spring, an intermittent surface-water feature situated about 1.6 kilometers (1 mile) northeast of the WCS CISF that contains water seasonally.
- Several cattle-watering holes where groundwater is pumped by windmill and stored in aboveground tanks.
- Monument Draw, a natural shallow drainageway situated several kilometers southwest of the WCS CISF. Local residents indicated that Monument Draw only contains water for a short period of time following a significant rainstorm (LES, 2005[2-19]).

The nearest residential areas are due west of the WCS CISF in the city of Eunice, New Mexico, which is approximately 8 km (5 mi) away. The closest residence from the center of the WCS CISF is approximately 6 km (3.8 mi) away on the east side of Eunice, New Mexico.

Population centers (more than 25,000 persons) and communities (places less than 25,000 persons) are shown below with distance from the site and 2010 census population (see Figure 2-25):

- Andrews, Andrews County, Texas: 32 miles southeast: 11,088 persons
- Eunice, Lea County, New Mexico: 6 miles west: 2,922 persons
- Hobbs, Lea County, New Mexico: 20 miles north; 34,122 persons
- Jal, Lea County, New Mexico: 23 miles south; 2,047 persons
- Lovington, Lea County, New Mexico: 39 miles north-northwest; 11,009 persons
- Seminole, Gaines County, Texas: 32 miles east-northeast; 6,430 persons
- Denver City, Gaines County, Texas: 40 miles north-northeast; 4,479 persons

For additional information regarding the demographics of the general project area and potential socio-economic impacts associated with the proposed WCS CISF, please refer to the Socioeconomic Impact Assessment in Appendix A of the Environmental Report.

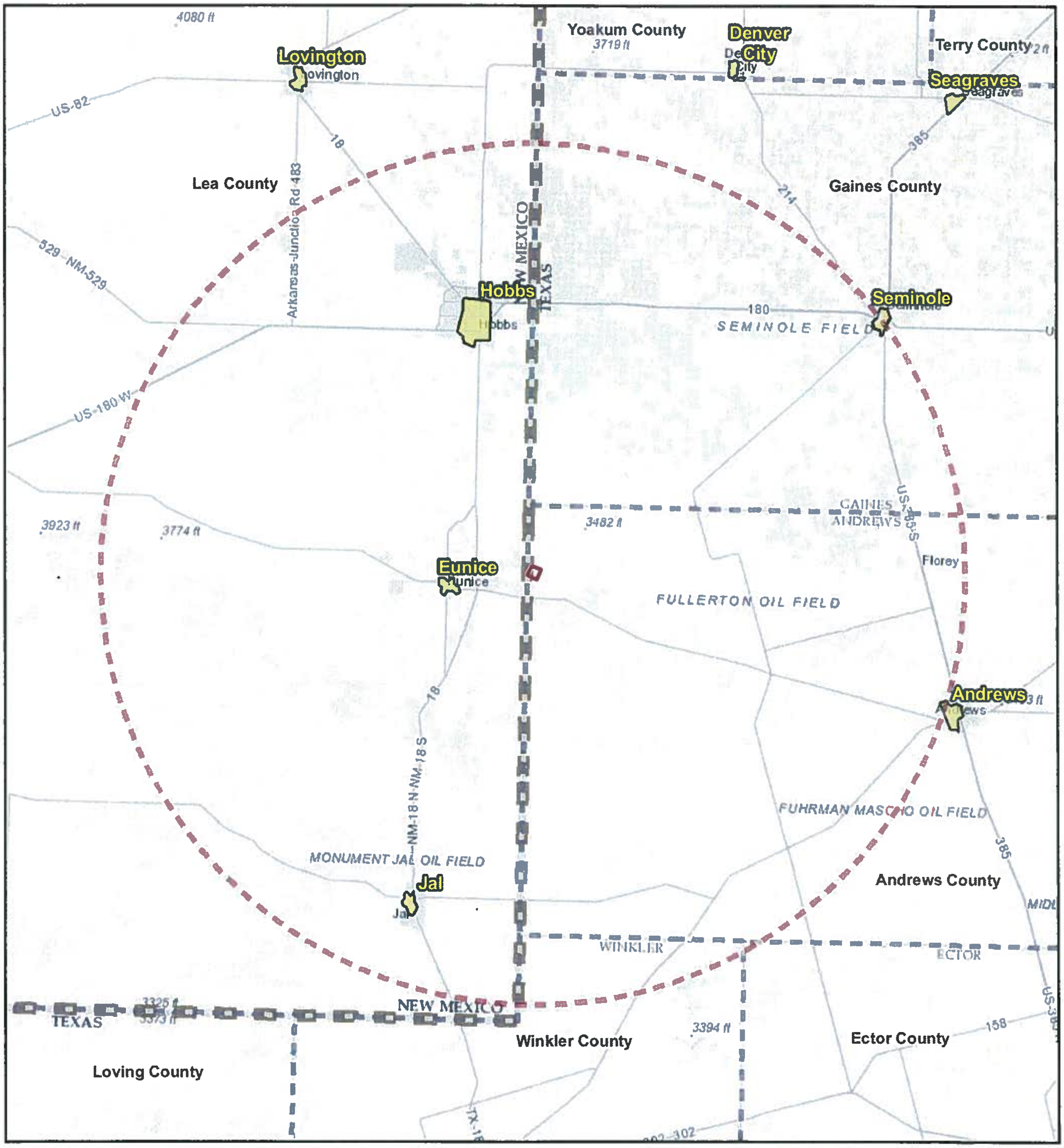
Population within a 5-mile radius centered on the proposed WCS CISF consists of scattered residences located in the eastern portion of the City of Eunice in Lea County, New Mexico. The closest residents to the WCS CISF reside within the 20 homes located approximately 4 to 5 miles west of the project. The locations of these homes with relation to the proposed WCS CISF estimated population counts are shown in Figure 2-19 Present Population Distribution within 5 miles of CS.

The estimated 2014 population within a 5-mile radius is 55 persons. This estimate assumes 20 households identified based on 2014 aerial photos superimposed with concentric one-mile radius circles. Household size was determined using an average household size of 2.71 persons according to 2010 census data for Census Tract 8/Block Group 2 in Lea County and by applying that average household size to the number of households identified. Because of the remoteness of the proposed WCS CISF and because a majority of the land within the 5-mile radius is owned by WCS, it is unlikely that the permanent population within a 5-mile radius would change significantly during the proposed license period.

No transient or institutional populations are known within 5 miles of the proposed WCS CISF. There are no known public recreation areas or state or federal parks within the 5-mile radius. Texas State Highway 176, a two-lane highway generally oriented east-west, is the only public transportation facility that provides access to the existing WCS commercial waste management facility. Land uses within a few miles of the WCS CISF include agriculture, cattle ranching, drilling for and production from oil and gas wells, quarrying operations, uranium enrichment, municipal waste disposal, and the surface recovery and land farming of oil field wastes.

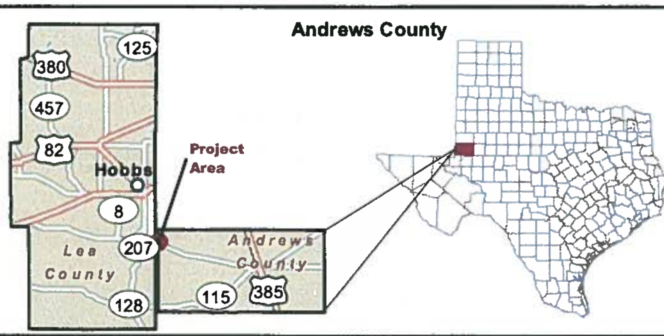
Based on U.S. Census Bureau decennial data, Lea County experienced a historical annual percentage growth rate of 0.55% from 1970 to 2010. Applying this historical annual percentage growth rate of 0.55%, the projected 2064 population within the 5-mile radius is 72 persons, an increase of 17 persons from the estimated 2014 population. Table 2.8 provides the population projection calculations for the populated sectors within a 5-mile radius of the proposed WCS CISF. This projection is conservative but appropriate given existing land uses and limited land area available for development. Figure 2.20 Projected Population Distribution within 5 Miles of WCS, illustrates the projected population distribution within the 5-mile radius based on the 0.55% annual percentage growth rate.

Two other possible scenarios were investigated based on 2010-2040 population projections prepared by the Geospatial and Populations Studies Group - University of New Mexico. Applying an annual percentage growth rate of 2.4 percent (based on projected Lea County Populations 2010-2040) results in a 2064 population projection of 177 persons. With a 1.2 percentage annual growth rate, which is half of the projected growth rate for Lea County (2010-2040), projected population by 2064 would be 100 persons. Tables 2-9 and 2-10 exhibit these calculations for the populated sectors within a 5-mile radius. Ultimately, these growth scenarios were deemed too aggressive given existing land uses and the limited land area available for development within populated sectors.



Project Location
30-mile Region of Interest
State Boundary
County Boundary

Data Source: US Census Bureau (2010)
Basemap Source: ESRI (2014)



0 10 Miles
0 15 Kilometers

Figure 2-25
Project Location - Road Base

Proposed Consolidated Interim Spent Fuel Storage Facility

COX | McLAIN Environmental Consulting

Prepared for: WCS	1 in = 10 miles
	Scale: 1:633,600
Prepared by: SL	Date: 4/4/2016

G:\Projects\WCS\Figure 1a_Project Location_20160404.mxd

1.0 CURRENT SOCIAL AND ECONOMIC CONDITIONS, INCLUDING BASELINE SOCIOECONOMIC DATA FOR THE REGION OF INTEREST

1.1 DEMOGRAPHIC PROFILE IN THE REGION OF INTEREST (ROI)

The existing WCS processing, storage, and disposal facility is in Andrews County, Texas, near the border of Lea County, New Mexico. Andrews, Texas, and Eunice, New Mexico, are the closest communities to the site at distances of approximately 32 miles southeast and six miles west, respectively. Population centers (more than 25,000 persons) and communities (less than 25,000 persons) are shown below with distance from the site and 2010 census population (see **Figure 1a**):

- Andrews, Andrews County, Texas: 32 miles southeast: 11,088 persons
- Eunice, Lea County, New Mexico: 6 miles west: 2,922 persons
- Hobbs, Lea County, New Mexico: 20 miles north; 34,122 persons
- Jal, Lea County, New Mexico: 23 miles south; 2,047 persons
- Lovington, Lea County, New Mexico: 39 miles north-northwest: 11,009 persons
- Seminole, Gaines County, Texas: 32 miles east-northeast: 6,430 persons
- Denver City, Gaines County, Texas: 40 miles north-northeast: 4,479 persons.

Population and Population Projections in the Region of Interest

Aside from these communities, the population density around the site is low. A majority of the ROI is in Andrews and Gaines Counties, Texas, with a large portion in Lea County, New Mexico. Small portions of the ROI fall in Winkler County and Ector County, Texas, so they are also included. **Table 1-1** shows the historical population of Texas and New Mexico Counties in the ROI from 1970 to 2010. All counties grew between 1970 and 2010 with the exception of Winkler County, which experienced population decline (26 percent) over the 40-year period. Andrews County grew by 43 percent between 1970 and 2010, while Gaines County grew 51 percent and Ector County (though the county's largest population center, Odessa, does not fall in the ROI) grew by 49 percent. The population in Lea County, New Mexico, grew by 22 percent.

Table 1-1: Historical Population of Counties in the Region of Interest, 1970–2010

Year	Andrews Co., TX	Gaines Co., TX	Winkler Co., TX	Ector Co., TX	Lea Co., NM*
1970	10,372	11,593	9,640	91,805	49,554
1980	13,323	13,150	9,944	115,374	55,993
1990	14,338	14,123	8,626	118,934	55,765
2000	13,004	14,467	7,173	121,125	55,511
2010	14,786	17,526	7,110	137,130	60,702
Percent change 1970 to 2010	43%	51%	-26%	49%	22%

Source: Texas Almanac, Population of Texas Counties 1850–2010.

*Lea County, New Mexico, data from U.S. Census (from WCS Socioeconomic Impact Assessment, 2008).

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-2.2

Provide a description of the onsite meteorological measurement program consistent with Regulatory Guide 1.23, which is cited in NUREG-1567. Section 2.3.3 of the WCS SAR provides a listing of the meteorological variables measured, and at which heights. Other information is needed to access accuracy, resolution, and range; such as a description the meteorological instrumentation that was used, detail on its emplacement and operation, types of sensors, instrument surveillance plans, and data acquisition and reduction methods.
This information is needed to determine compliance with 10 CFR 72.90.

WCS RSI 2.2 Response

WCS has provided the requested information in WCS SAR Chapter 2, Section 2.3.3.

WCS has provided a new attachment for WCS SAR Chapter 2. Attachment G, Technical Specifications for Towers, is provided on enclosed disk 1.

2.3.3 Onsite Meteorological Measurement Program

Meteorological data have been collected on the WCS property from four (4) meteorological towers stations. The towers were located in positions where the measurements will accurately represent overall site meteorology for the WCS site. The map-shown in Figure 2-4 illustrates where the stations are located in relation to the WCS facility. The equipment is checked daily and calibrated quarterly. WCS follows a meteorological measurement program that is consistent with Regulatory Guide 1.23, which is cited in NUREG-1567. Details for each station at the WCS site are ~~and~~ listed below:

- WCS stations on-site include Tower 1 (Figure 21-1), which has been collecting data since March 2009, ~~and it~~ measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. WCS has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals. Tower 1 was installed using a Met One Model 970666 30-foot guyed fold over tower. Specifications for the instrumentation and install are in Attachment G.

- The ER Tower (Figure 2-22) which has been collecting data since July 2009 measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. WCS has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals. The ER Tower was installed using a Met One Model 970666 30-foot guyed fold over tower. Specifications for the instrumentation and install are in Attachment G.

- The WeatherHawk West and East Tower (Figures 2-23 and 2-24) have~~s~~ been collecting data since March 2009. They ~~and theyit~~ measure~~s~~ temperature, wind direction, wind speed, relative humidity, barometric pressure, solar radiation, and rain at roughly 4 meters~~10 feet~~. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. Specifications for the instrumentation and install are in Attachment G.

Measurements for all parameters, listed in Table 2-11 are taken at 10 minute, 60 minute and 24 hour averages and recorded/stored on a dedicated Campbell Scientific data logger at each station. Routinely the data loggers automatically download their content to a server in Dallas, TX for long-term storage. Data loggers can be remotely accessed via password protected radio telemetry; and the server can be securely accessed via a password protected internet connection. The table below lists the meteorological parameters measured and at what heights.

TABLE 2-11: Meteorological Tower Measurements

Parameter (Ht above Grnd	Weather Station				Instrument Manufacturer
	Tower 1	ER Tower	WH East	WH West	
Wind Spd (2 Meters)	X	X			Met One
Wind Spd (10 Meters)	X	X			Met One
Wind Spd (4 Meters)			X	X	Weather Hawk*
Wind Dir (2 Meters)	X	X			Met One
Wind Dir (10 Meters)	X	X			Met One
Wind Dir (4 Meters)			X	X	Weather Hawk*
Air Temp [°F] (2 Meters)	X	X			Met One
Air Temp [°F] (10 Meters)	X	X			Met One
Air Temp [°F] (4 Meters)			X	X	Weather Hawk*
Relative Humidity (2 Meters)	X	X			Met One
Relative Humidity (10 Meters)	X	X			Met One
Relative Humidity (4 Meters)			X	X	Weather Hawk*
Barometric Press (2 meter)	X	X			Met One
Barometric Press (4 Meters)			X	X	Weather Hawk*
Solar Radiation (2 Meters)	X	X			Met One
Solar Radiation (4 Meters)			X	X	Weather Hawk*
Rain [Tip Bucket] (Ground)	X	X			Met One
Rain [Tip Bucket] (Ground)			X	X	Weather Hawk*

* Weather Hawk is a Division of Campbell Scientific.

Information for the Met One Towers and the WeatherHawk Series regarding range, accuracy, and resolution is listed in the Table 2-12.

~~The WeatherHawk East Tower has been collecting data since March 2009 and it measures temperature, wind direction, wind speed, relative humidity, barometric pressure, solar~~

~~radiation, and rain at roughly 10 feet. Data averages, unless otherwise noted, are based on available historic records from 2009-2015.~~

Table 2-12 Meteorological Tower Sensors

Parameter	Sensor	Range	Accuracy	Resolution
WeatherHawk Series 500				
Air Temperature	Capacitive Ceramic	-60 - +140 F	+/-0.9 F @ -40 to 125 F	0.1 F
Relative Humidity	Capacitive thin-film polymer	0-100%	+/- 3% @ 0-90%RH; +/-5% @ 90-100%RH	0.1%
Barometric Pressure	Capacitive Silicon	17.72-32.48 inHg (60-110 kPa)	0.15 inHg @ +32 to +86 F (+-.05 kPa @0-32 C)	.03 inHg @-60 to +140 F (+-.1 kPa @-52 to +60 C)
Solar Radiation	Silicon Pyranometer	300 to 1100 nm (Spectral Range)	Reproducibility +/-2%	Infinite
Rain	Piezoelectric	9.3 in^2 (collecting area)_	<5% (weather dependent)	.001 in
Wind Direction	Ultrasonic	0-360 deg (Azimuth)	+/- 2 deg	1 deg
Wind Speed	Ultrasonic	0-134 mph	+/-.67 mph (+/- 0.3m/s) or +/- 2% whichever is greater	.22 mph (0.1 m/s)
Met One Towers				
Air Temperature	Themistor	-50 to +50 C	+/- 0.10 C	Analog Output with Infinite Resolution
Relative Humidity	Capacitive thin-film polymer	0-100%	+/-3% @ 0-10% and 90-100%; +/- 2% @ 10-90%	Analog Output with Infinite Resolution
Barometric Pressure	Active Solid-State Device	0-100%	+/-0.125% FS	Analog Output with Infinite Resolution
Solar Radiation	Pyranometer	0.4 to 0.7 micrometers	+/- 5%	Analog Output with Infinite Resolution
Rain	Dual-chambered tipping bucket that activates a reed switch	8 in^2 (collecting area)	@ 0.5"/hour +/- 0.5%; @ 1" to 3"/hour +/- 1.0%	0.01"
Wind Direction	Wire-wound potentiometer	0-360 deg	+/-5 deg	Analog Output with Infinite Resolution

Wind Speed	3-cup anemometer	0-125 mph	+/-1.5% or 0.25 mph	1.79 mph @ 1 sec; 0.03 mph @ 1 min

Add to Section 2.3.1.2 at the end of section

Change title to "Extreme Winds and Atmospheric Stability"

The neighboring NEF site analyzed wind speed and direction from the Midland-Odessa First Order weather station for the years 1987 to 1991. Calculated annual mean wind speed was 5.1 meters per second (11.4 miles per hour), with prevailing winds from the south and a maximum 5-second wind speed of 31.2 meters per second (70 miles per hour). The Pasquill stability classes range from A to F, with the most stable classes – E and F – occurring 18.9 and 13 atmospheric percent of the time, respectively. The least stable classes, A and B, occur 0.3 and 3.5 percent of the time, respectively. NEF compared this data against data generated at WCS from October 1999 through August 2002, and found similar wind patterns and distribution of wind speed between Midland-Odessa and WCS locations (EIS for NEF, 2005).

2.3 Meteorology

2.3.1 Regional Climatology

The Weather Forecast Office at Midland, Texas covers the High Plains where the proposed WCS CISF is located. The climate of the WCS CISF in Andrews County, TX can best be described as "semi-arid continental" marked with four seasons. Summers are typically hot, dry weather with the relative humidity being generally low. July is the hottest month with high temperatures occasionally reaching above 100 degrees Fahrenheit. January is the coldest month, although the winters are not generally severe. Temperatures occasionally dip below 32 degrees Fahrenheit.

Precipitation levels are generally very low in this arid climate. The precipitation tends to be heavier in the summer and fall.

During the winter, the regional weather is often dominated by a high-pressure system in the central part of the western United States and a low-pressure system in north-central Mexico. The region is affected by a low-pressure system located over Arizona in the summer.

2.3.2 Local Meteorology

The Weather Forecast Office at Midland-Odessa, Texas covers the High Plains where the proposed WCS CISF is located. In addition to the weather forecast office in Midland, climatological data for atmospheric variables such as temperature, pressure, winds, and precipitation are also collected at stations in Jal, New Mexico; Hobbs, New Mexico; and Andrews, Texas. Table 2-1 indicates the distances and directions of these stations from the WCS CISF and the length of record for the reported data.

The Midland-Odessa monitoring station is the closest first-order National Weather Service station to the WCS CISF. First-order weather stations record a complete range of meteorological parameters for 24-hour periods, and they are usually fully instrumental and I operated by the National Weather Service (http://www.ncdc.noaa.gov/homr/).

2.3.3 Onsite Meteorological Data

Meteorological data have been collected on the WCS property from four (4) meteorological tower stations. The towers were located in positions where the measurements will accurately represent overall site meteorology for the WCS site. The map show in Figure 2-4 illustrates where the stations are located in relation to the WCS facility. The equipment is checked daily and calibrated quarterly. WCS follows a meteorological measurement program that is consistent with Regulatory Guide 1.23, which is cited in NUREG-1567. Details for each station at the WCS site are listed below:

- WCS stations on-site include Tower 1 (Figure 2-21), which has been collecting data since March 2009, measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. WCS has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals. Tower 1 was installed using a Met One Model 970666 30-foot guyed fold over tower. Specifications for the instrumentation and install are in Attachment G.

- The ER Tower (Figure 2-22) has been collecting data since July 2009 measures temperature, wind direction, wind speed, relative humidity at 2 and 10 meters, barometric pressure, solar radiation, and rain at 2 meters only. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. WCS has sensors at both the 2-meter (lower) and 10-meter (upper) height intervals. The ER Tower was installed using a Met One Model 970666 30-foot guyed fold over tower. Specifications for the instrumentation and install are in Attachment G.

- The WeatherHawk West and East Tower (Figures 2-23 and 2-24) have been collecting data since March 20099.They measure temperature, wind direction, wind speed, relative humidity, barometric pressure, solar radiation, and rain at roughly 4 meters. Data averages, unless otherwise noted, are based on available historic records from 2009-2015. Specifications for the instrumentation and install are in Attachment G.

Measurements for all parameters, listed in Table 2-11, are taken at 10 minute, 60 minute and 24 hour averages and recorded/stored on a dedicated Campbell Scientific data logger at each station.

2.3.3.1 Maximum and Minimum Temperatures

The Western Regional Climate Center (www.wrcc.dri.edu) has historic temperature data for Andrews, TX. The temperature data currently available spans from 1962 until 2010. The average maximum and minimum temperatures, the record high temperature and low temperature for each month, and the annual high and low temperature for these years is shown on Table 2-2. In Andrews, TX the average annual maximum temperature is 77.5 degrees Fahrenheit and the average annual minimum temperature is 49.6 degrees Fahrenheit.

The normal temperature range for the WCS CISF is 44.1 degrees Fahrenheit to 81.5 degrees Fahrenheit (mean monthly temperature). The off-normal maximum and minimum temperature is 30.1 degrees Fahrenheit and 94.6 degrees Fahrenheit (mean daily temperature). The extreme temperature minimum is -1 degree Fahrenheit and the maximum is 113 degrees Fahrenheit (Table 2-2).

2.3.3.2 Extreme Winds and Atmospheric Stability

Regionally wind speeds are usually more moderate, although relatively strong winds often accompany occasional frontal activity during late winter and spring months and sometimes occur just in advance of thunderstorms. Frontal winds may exceed 13 meters per second (30 miles per hour) for several hours and reach peak speeds of more than 22 meters per second (50 miles per hour).

Wind speed and direction data measured at the on-site WCS meteorological stations from 2010 to 2015 is shown on wind rose diagrams in Figure 2-4, Figure 2-5, Figure 2-6, Figure 2-7, and Figure 2-8. The data used to create the wind rose diagrams is located on compact discs in Attachment A. The wind roses show the percent of the time (rings) that the wind blows from each of the 16 directions (N, NNE, NE, NNW) by the length of the bars. The shading of the bars also indicates the frequency of occurrence of wind speeds within the wind speed classes shown on the figures. The on-site data indicates that for this period from 2010 to 2015 the average wind speed ranged from 6.07 knots to 10.53 knots. The wind direction is predominantly from the south. The diagrams indicate that wind gusts in excess of 22 mph generally blow from the southwest or northeast.

The neighboring NEF site analyzed wind speed and direction from the Midland-Odessa First Order weather station for the years 1987 to 1991. Calculated annual mean wind speed was 5.1 meters per second (11.4 miles per hour), with prevailing winds from the south and a maximum 5-second wind speed of 31.2 meters per second (70 miles per hour). The Pasquill stability classes range from A to F, with the most stable classes – E and F – occurring 18.9 and 13 atmospheric percent of the time, respectively. The least stable classes, A and B, occur 0.3 and 3.5 percent of the time, respectively. NEF compared this data against data generated at WCS from October 1999 through August 2002, and found similar wind patterns and distribution of wind speed between Midland-Odessa and WCS locations (EIS for NEF, 2005).

2.3.3.3 Tornado and Sever Weather Conditions

Two F2 Class (wind speed from 113 to 157 mph) tornadoes have been recorded in Andrews County, TX from 1950 through 2015 according to data reported by NOAA. NOAA reports there were eight F1 Class (wind speed 73 to 112 mph) tornadoes recorded in Andrews County since 1950. No F4 or F5 tornados have ever been reported in the vicinity of the WCS CISF.

Tornados are classified using the F-scale with classifications ranging from F0-F5 as follows:

- F0-classified tornados have winds of 64 to 116 kilometers per hour (40 to 72 miles per hour)
- F1-classified tornados have winds of 117 to 181 kilometers per hour (73 to 112 miles per hour)

Table 2-11 Meteorological Tower Measurements

Parameter (Ht above Grnd	Weather Station				Instrument Manufacturer
	Tower 1	ER Tower	WH East	WH West	
Wind Spd (2 Meters)	X	X			Met One
Wind Spd (10 Meters)	X	X			Met One
Wind Spd (4 Meters)			X	X	Weather Hawk*
Wind Dir (2 Meters)	X	X			Met One
Wind Dir (10 Meters)	X	X			Met One
Wind Dir (4 Meters)			X	X	Weather Hawk*
Air Temp [°F] (2 Meters)	X	X			Met One
Air Temp [°F] (10 Meters)	X	X			Met One
Air Temp [°F] (4 Meters)			X	X	Weather Hawk*
Relative Humidity (2 Meters)	X	X			Met One
Relative Humidity (10 Meters)	X	X			Met One
Relative Humidity (4 Meters)			X	X	Weather Hawk*
Barometric Press (2 meter)	X	X			Met One
Barometric Press (4 Meters)			X	X	Weather Hawk*
Solar Radiation (2 Meters)	X	X			Met One
Solar Radiation (4 Meters)			X	X	Weather Hawk*
Rain [Tip Bucket] (Ground)	X	X			Met One
Rain [Tip Bucket] (Ground)			X	X	Weather Hawk*

Table 2-12 Meteorological Tower Sensors

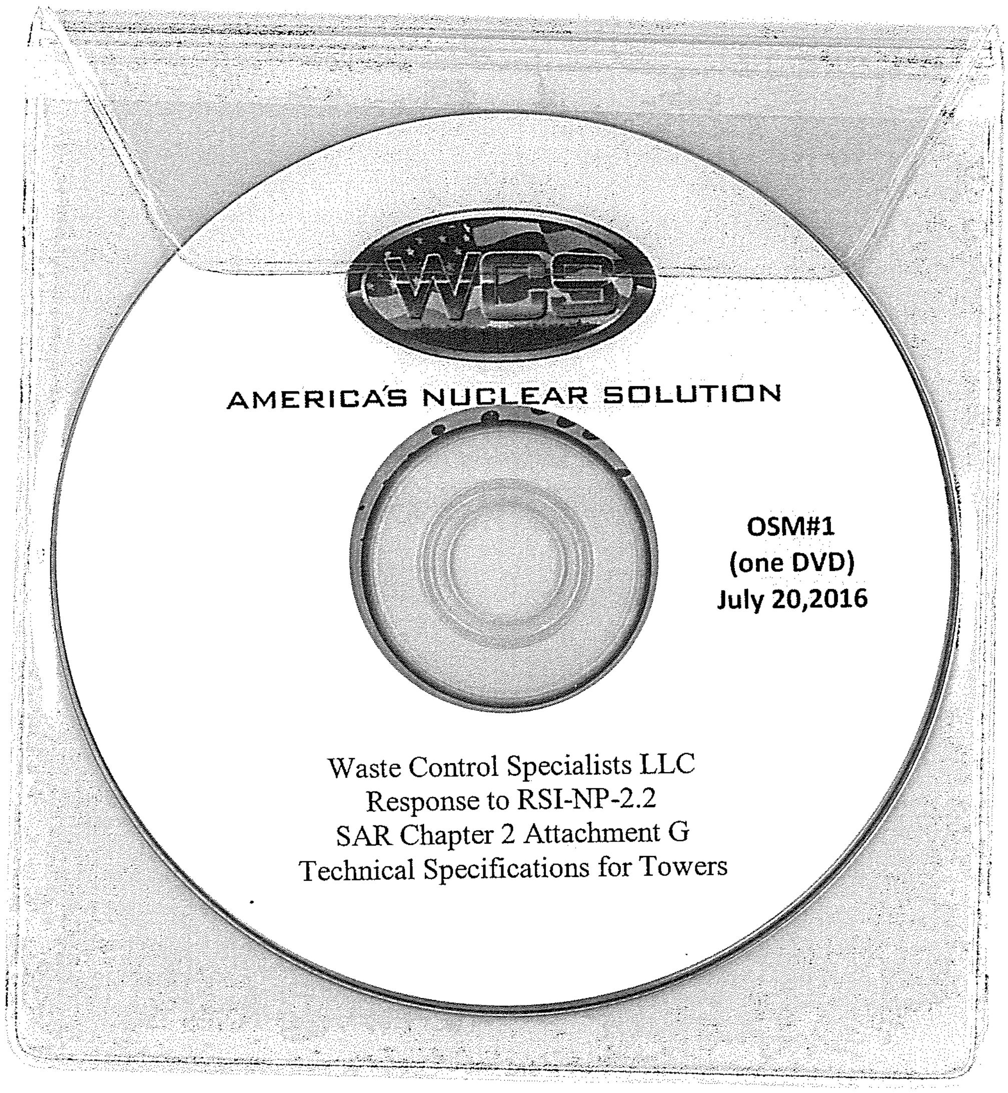
Parameter	Sensor	Range	Accuracy	Resolution
WeatherHawk Series 500				
Air Temperature	Capacitive Ceramic	-60 - +140 F	+/-0.9 F @ -40 to 125 F	0.1 F
Relative Humidity	Capacitive thin-film polymer	0-100%	+/- 3% @ 0-90%RH; +/-5% @ 90-100%RH	0.1%
Barometric Pressure	Capacitive Silicon	17.72-32.48 inHg (60-110 kPa)	0.15 inHg @ +32 to +86 F (+-.05 kPa @0-32 C)	.03 inHg @-60 to +140 F (+-.1 kPa @-52 to +60 C)
Solar Radiation	Silicon Pyranometer	300 to 1100 nm (Spectral Range)	Reproducibility +/-2%	Infinite
Rain	Piezoelectric	9.3 in^2 (collecting area)_	<5% (weather dependent)	.001 in
Wind Direction	Ultrasonic	0-360 deg (Azimuth)	+/- 2 deg	1 deg
Wind Speed	Ultrasonic	0-134 mph	+/-.67 mph (+/- 0.3m/s) or +/- 2% whichever is greater	.22 mph (0.1 m/s)
Met One Towers				
Air Temperature	Themistor	-50 to +50 C	+/- 0.10 C	Analog Output with Infinite Resolution
Relative Humidity	Capacitive thin-film polymer	0-100%	+/-3% @ 0-10% and 90-100%; +/- 2% @ 10-90%	Analog Output with Infinite Resolution
Barometric Pressure	Active Solid-State Device	0-100%	+/-0.125% FS	Analog Output with Infinite Resolution
Solar Radiation	Pyranometer	0.4 to 0.7 micrometers	+/- 5%	Analog Output with Infinite Resolution
Rain	Dual-chambered tipping bucket that activates a reed switch	8 in^2 (collecting area)	@ 0.5"/hour +/- 0.5%; @ 1" to 3"/hour +/- 1.0%	0.01"
Wind Direction	Wire-wound potentiometer	0-360 deg	+/-5 deg	Analog Output with Infinite Resolution
Wind Speed	3-cup anemometer	0-125 mph	+/-1.5% or 0.25 mph	1.79 mph @ 1 sec; 0.03 mph @ 1 min

Figure 2-21 Tower 1 Located South of the WCS Guard House

Figure 2-22 ER Tower Located on the North Side of the WCS Federal Waste Facility

Figure 2-23 WeatherHawk East Located on the East Side of the Permitted Area for WCS (North of the Rail Loop)

Figure 2-24 WeatherHawk West Located West of the WCs LSA Pad Next to State Line Road


AMERICA'S NUCLEAR SOLUTION
OSM#1
(one DVD)
July 20,2016
Waste Control Specialists LLC
Response to RSI-NP-2.2
SAR Chapter 2 Attachment G
Technical Specifications for Towers

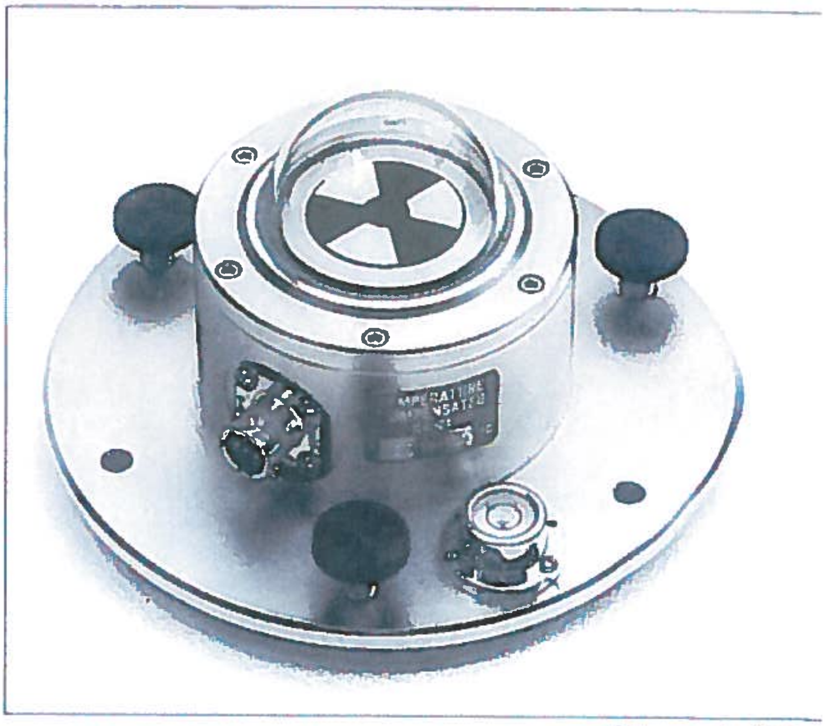
Attachment G

Technical Specifications for Towers

(120 pages)

Solar Radiation Sensors

Solar energy is a significant element in large-scale atmospheric motion, and as a result it has an important place in meteorology. It is directly related to atmospheric stability, and is used in determining stability classes for pollution studies. Met One Instruments supplies solar sensors to meet virtually any monitoring requirement.



Model 095

Model 095 Pyranometer

The Model 095 Pyranometer incorporates a multi-junction differential thermopile and a precision ground optical glass hemisphere which is transparent to wave lengths 0.285 to 2.80 microns. It is used for high-precision, broad-band measurements of incident solar radiation.

Features

- Differential thermopile detector
- High accuracy, broad bandwidth
- Temperature compensated
- Rapid response time
- Built-in leveling devices

The detector element is of wirewound-plated construction with black and white segments. When exposed to solar radiation the differing absorptivity of the black and white surfaces develops a temperature differential. The thermopile then produces a voltage proportional to the solar radiation. Built in thermistor circuitry is incorporated to eliminate the effects of ambient temperature.

The single hemispherical optical glass dome has a waterproof seal, but can easily be removed for repairs. The case is cast aluminum, painted white, and is fitted with a desiccator, circular level, and leveling screws. A mounting base with a vertical 3/4" IPS pipe simplifies field installation of the sensor. This rugged instrument is capable of withstanding mechanical vibrations of up to 20 G's.

Solar Sensor Specifications

	Model 095	Model 394	Model 096	Model 097
Spectral Response				
nanometers	285 to 2800	285 to 2800 (clear)*	400 to 1100	250 to 60000
microns	0.28 to 2.80	0.28 to 2.80 (clear)	0.4 to 1.1	0.25 to 60
Calibration	Integrating hemisphere approx. 1 cal cm^{-2} min^{-1}, at 25°C	Integrating hemisphere approx. 1 cal cm^{-2} min^{-1}, at 25°C	against Eppley B&W under natural daylight	against transfer standard and compared to a tungsten-halide light source
Sensitivity**	11 mV/kwatt meter^{-2}, approx.	9 mV/kwatt meter^{-2}, approx.	8.0 mV/kwatt meter^{-2} with 100 Ohm load, approx.	75 mV/kwatt meter^{-2}, approx.
Impedance	350 Ohms, approx.	650 Ohms	100 Ohm load (dependent upon sensor sensitivity)	4 Ohms
Temperature Dependence	±1.5% constancy from -20 to +40° C	±1% constancy from -20° to +40° C	±0.15%/degree C, maximum	N/A
Linearity	±1% from 0 to 1400 watts meter^{-2}	±0.5% from 0 to 2800 watts meter^{-2}	±1% from 0 to 3000 watts meter^{-2}	N/A
Response time	5 seconds (1/e signal)	1 second (1/e signal)	10 microseconds (10% to 90%)	10.5 seconds
Cosine Response	±2% from normalization 0°-70° zenith angle; ±5% 70°-80° zenith angle	±1% from normalization 0°-70° zenith angle ±3% from 70°-80° zenith angle	Corrected up to 82° incident angle. Azimuth error less than 1% over 360° at 45° elevation	N/A
Physical				
Size (including mount)	5.75" dia. x 21" H	5.75" dia. x 23" H	3" dia. x 19" H	2.8" W x 2.5" H x 37" L
Weight (including mount)	4 lbs (1.8 KG)	9 lbs (4 KG)	1.2 lbs (.54 KG)	3 lbs (1.3 KG)
Mounting	Leveling plate and mounting base included Requires #1552 fitting or similar device	Leveling plate and mounting base included Requires #1552 fitting or similar device	Leveling plate and mounting base included Requires #1552 fitting or similar device	Mounting plate for support arm included
Cable (xx = length in feet)	#1138-xx	#1138-xx	#1832-xx	#2437-xx

* Contact factory for other ranges.

** Sensitivity varies among sensors of the same type.
A Calibration Certificate is supplied with each sensor.

MODEL 96-1
SOLAR RADIATION SENSOR

OPERATION MANUAL

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 214-412-4747
Facsimile 214-412-4716

096-1 SOLAR RADIATION SENSOR

1.0 GENERAL INFORMATION

1.1 The Model 096-1 Solar Radiation Sensor is an accurate and sensitive sensor using a LI-COR sensing element and designed for the continous measurement of solar radiation. Typically, the sensor is mounted with the 1289 Mounting Plate.

1.2 Spectral Response. The relative spectral response of the silicon photodiode does not extend uniformly over the full solar radiation range. A typical response curve is presented in Figure 1.1. The response is very low at 0.4 µm and then increases nearly linear to a cutoff near 1.1 µm. Changes in the spectral distribution of the incident light, coupled with the non-uniform spectral response, can cause errors in the photodiode output. Hull[3] shows that in the 0.4 to 0.7 µm range, the spectral distribution of sun plus sky radiation on a horizontal surface is remarkably constant even when clear and overcast days are compared. However, Gates[2] indicates that the major change in spectral distribution of solar radiation occurs in the near infared where water vapor absorption takes place on cloudy days. Data collected at low solar elevations can show significant error because of altered spectral distribution which changes in atmospheric transmission. This is a small part of the daily total so the possible observed error usually has an insignificant effect on daily integrations.

The area under the spectral irradiance curve of the source is directly porportional to the energy received by a horizontal surface. Under specific but typical conditions, energy received on a completely overcast day has been estimated to be 11.3% of that received on a clear day. When both spectral distributions are weighted according to a typical response curve of a silicon photodiode, the response on this cloudy day is 12.6%. Therefore, errors incurred under different sky conditions, due to the spectral response of the photodiode, will be small. The field tests of Federer and Tanner[1] and Kerr, Thurtell and Tanner[4] confirm this conclusion.

1.3 Calibration. The 096-1 Pyranometer has been calibrated against an Eppley Precision Spectral Pyramonmeter (PSP) of which the calibration is periodically confirmed. The calibration was performed under daylight conditions by a computer sampling of instantaneous readings from the Eppley and LI-COR pyranometers. Instantaneous readings were taken continuously for 10 minutes and then averaged. Sequential ten minute averaging periods were run from sunup to sundown for 3-4 days. These ten minute averages were then evaluated and used to compute an average calibration constant. The uncertainty of calibration is ± 5%.

Table 1-1
Model 096-1 Solar Radiation Sensor Specifications

Calibration	Calibrated against an Eppley Pyranometer under natural daylight clear conditions. Absolute accuracy under these conditions is ±5%. All sensors are calibrated to within 1% of each other.

Sensitivity	Typically 80 microamp/1000 watts m^{-2}.
Linearity	Maximum deviation of 1% to 3000 watts m^{-2}.
Stability	Less than 2% change over a 1 year period.
Response Time (10-90%)	10 microseconds
Temperature Dependence	± .15% per °C maximum
Cosine Correction	Cosine corrected up to 82° angle of incidence.
Azimuth Error	Less than 1% over 360° at 45° elevation.
Sensor Case	Weather-proof anodized aluminum case with diffuser and stainless steel hardware. Precision level supplied.
Mounting	A 1289 Mounting Plate is provided.

2.0 INSTALLATION

2.1 096-1 Solar Radiation Sensor Installation

A. Typically, the sensor is mounted to the 1289 Mounting Plate. Refer to Figure 2-1. Using a 1552 Mounting Clamp, the radiation sensor and mounting plate may be directly mounted to Met One Instruments' Model 191 Mounting Arm, or similar.

B. For proper operation it is necessary that the sensor be level. Level the sensor using the three outer screws. Lock into place using three inner screws.

C. The sensor is supplied with an attached 1832 cable. The white or red wire is the + signal. The black wire is the common.

3.0 096-1 SOLAR RADIATION SENSOR CHECK-OUT

3.1 Model 096-1 Solar Radiation Sensor has been calibrated at the factory. It will not change unless it is damaged. To check for proper operation of the sensor, expose the sensor to bright sunlight and check datalogger or translator for reasonable output, and then completely cover the sensor with a black tape and check for an output of near zero.

3.2 When this sensor is used with a Met One Instruments translator, the translator calibration is matched to the individual sensor. If used with dataloggers or other recording devices the use of a terminating resistor is required.

3.3 Terminating Resistor

A. The resistor is used to convert the current output signal to a voltage output signal, and is required when the sensor is connected to millivolt recording devices.

B. A precision 100Ω or150Ω resistor has been supplied with the sensor to allow for the correct interface between the sensor and millivolt recording electronics (<u>not required when the 096-1 is used with the Met One Instruments Translator circuit cards</u>). Place this resistor in parallel with the signal leads from the sensor. The output signal is then equal to:

Mv = I * R
Where:
Mv = Output microvolts
I = Output signal in microamps
R = Resistance in ohms of terminating resistor

4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule*

A. Inspect sensor for proper operation as per Section 3.0.

B. Clean sensor element monthly using clean rag or tissue.

*Schedule is based on average to adverse environments.

REFERENCES

1. Federer, C.A., and C.B. Tanner,1965. A simple integrating pyranometer for measuring daily solar radiation. J. Geophys, Res. 70, 2301-2306.
2. Gates, D.M.,1965. Radiant energy, its receipt and disposal. Meteor. Monogr.,6,No.28, 1-26.
3. Hull,J.N.,1954. Spectral distribution of radiation from sun and sky. Trans.Illun.Eng. Soc.(London),19:21-28.
4. Kerr, J.P.,G.W Thurtell, and C.B. Tanner,1967. An integrating pyranometer for climatological observer stations and mescoscale networks. Journal of Applied Meteorology,6,688-0694.

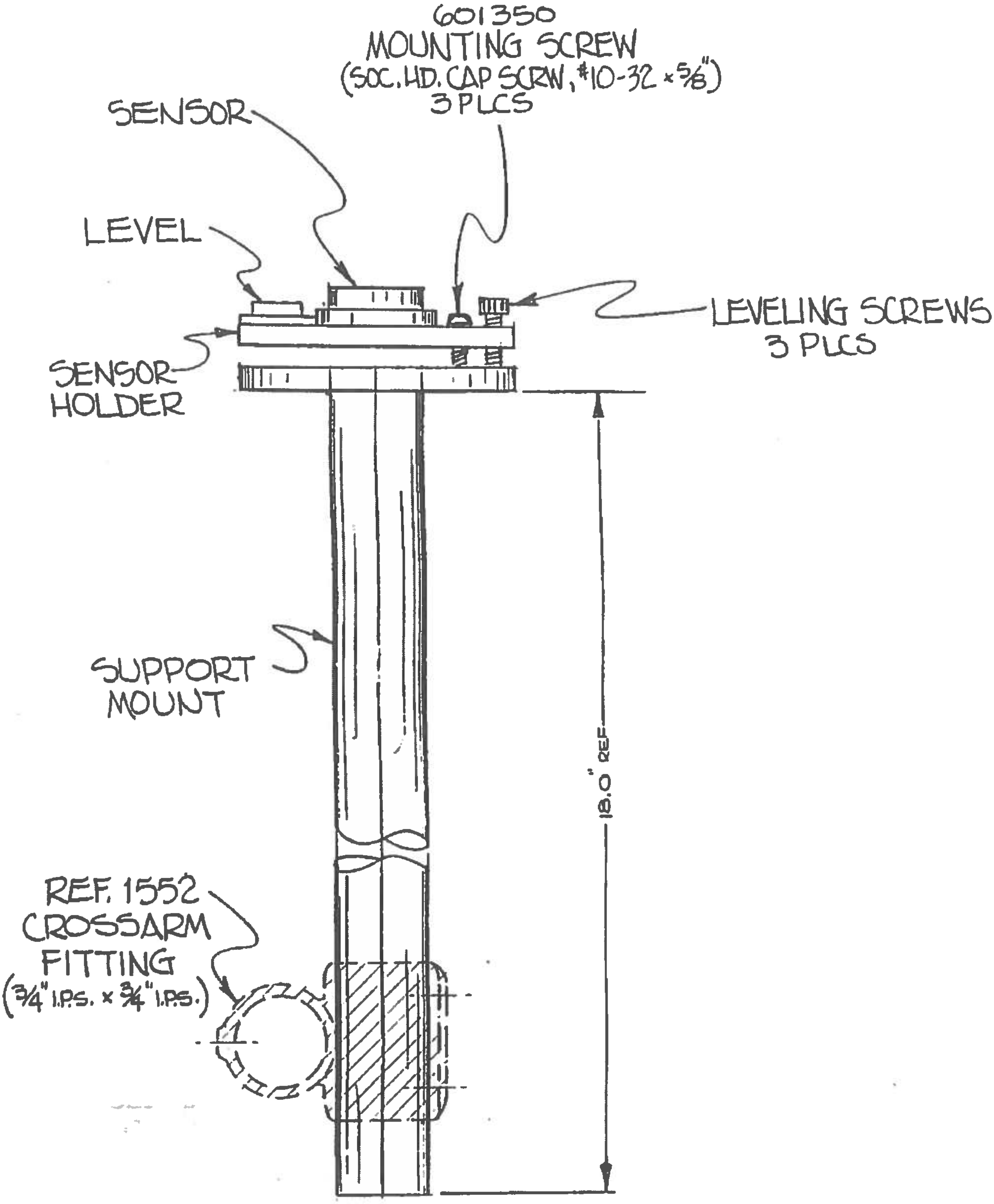
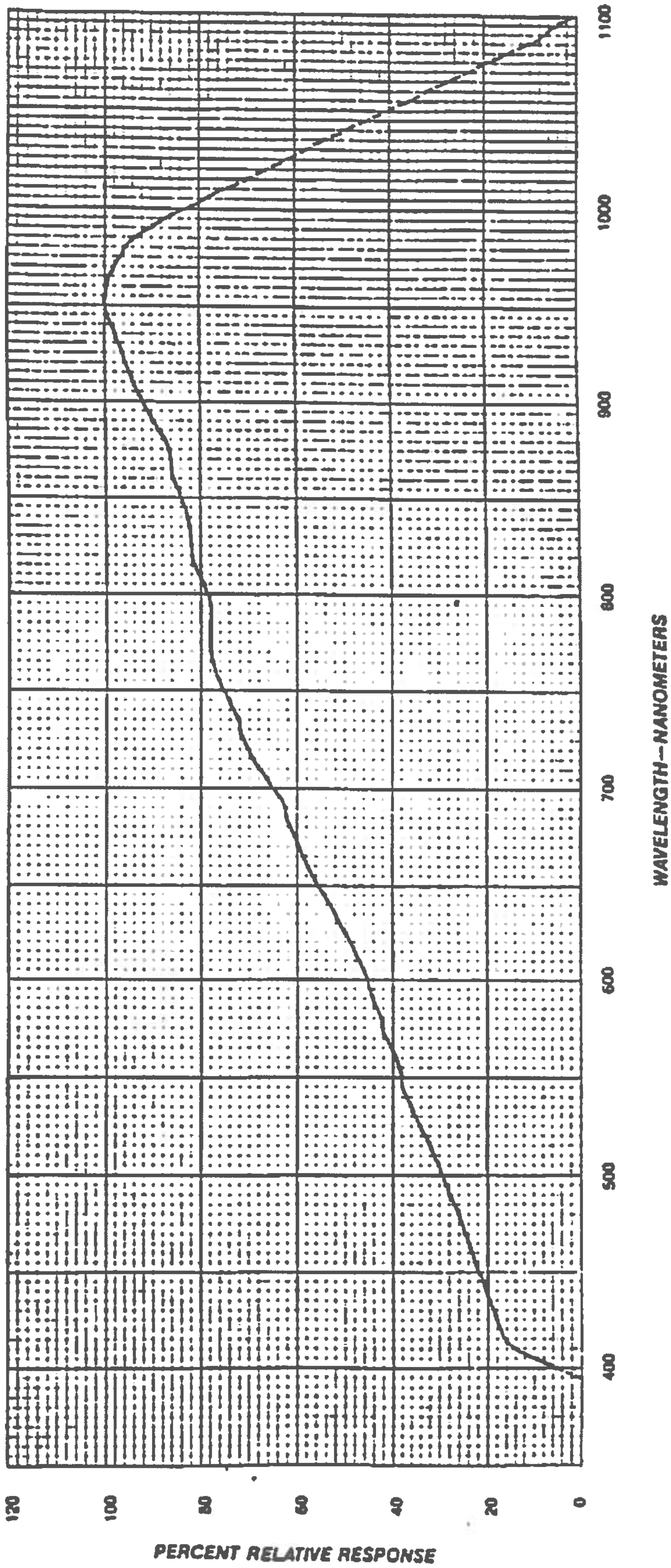


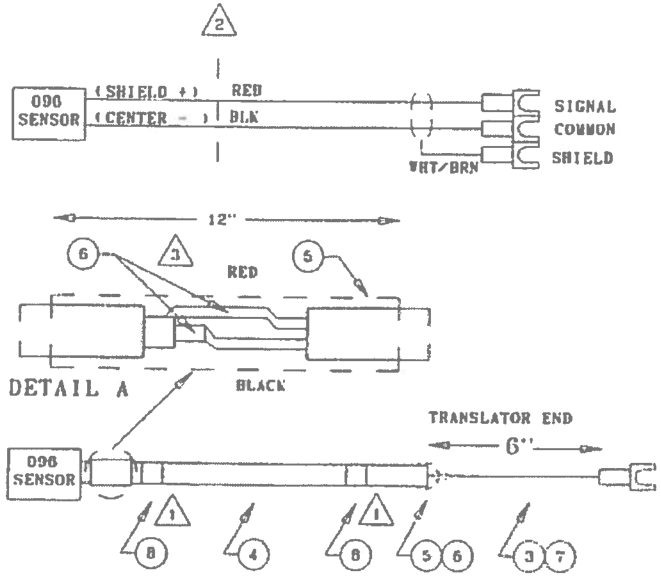
FIGURE 2-1
096-1 WITH 1289 SUPPORT MOUNT



PERCENT RELATIVE RESPONSE
0
20
40
60
80
100
120
WAVELENGTH—NANOMETERS
400
500
600
700
800
900
1000
1100

FIGURE 1-1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REDRAWN W/PARTS LIST	9/16/91	DH



ITEM	PART NO.	DESCRIPTION	QTY
1			
2			
3	600193	LUG, SPADE, #6	3
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	900050	SLEEVING, 1/4", SHRINK	12"
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

1. IDENTIFY CABLE 18" FROM EACH END.
   DASH NUMBER = LENGTH IN FEET.

2. SPLICE 1832 CABLE TO 096 SENSOR CABLE AS SHOWN IN DETAIL A.

3. COVER EACH WIRE SPLICE SEPARATELY.

MET ONE INSTRUMENTS

ASSY, CABLE, 096
SOLAR RADIATION

SIZE	FSCM NO.	DWG NO 1832	REV C
SCALE		SHEET 1 OF 1	

Wind Speed Sensor

014A

The Model 014A Wind Speed Sensor is an accurate, durable, and economical anemometer suitable for a wide range of wind study applications. It is designed for long term unattended operation in most meteorological environments.

Features

- Range to 100 mph
- Low starting threshold
- Broad temperature operating range
- Accuracy of ±1.5%
- Stainless steel and aluminum construction

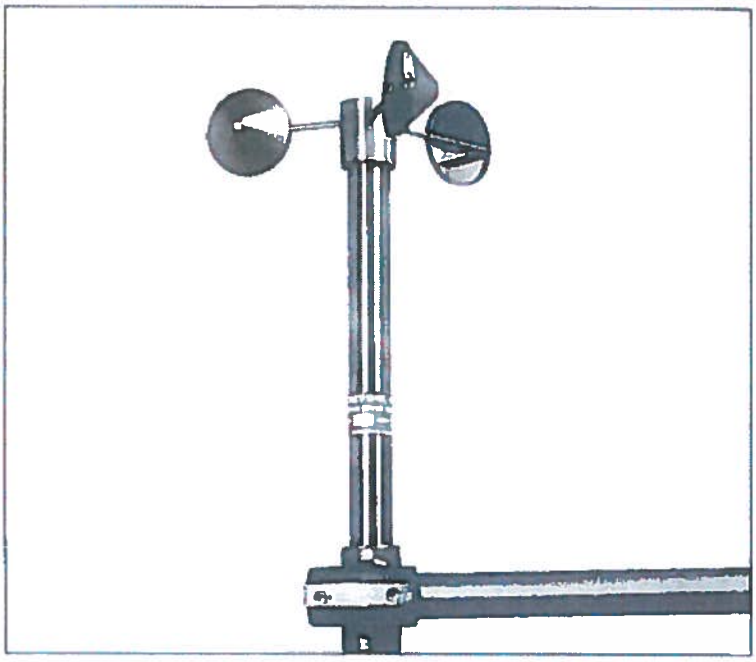
Operation

For maximum operational reliability, the sensor uses a sealed magnetic read switch. This switch produces a series of contact closures at a rate proportional to wind speed. With its pulsed output, the Model 014A lends itself to applications involving both digital and analog measurement systems.

The pulsed signal may be converted to standardized analog voltage and/or current output by use of translator electronics. Direct connection to a datalogger is also possible. The robust aluminum cup assembly normally supplied has a distance constant of <15 feet. For greater sensitivity, the optional Lexan plastic cup assembly may be specified, which has a distance constant of <5 feet.

Construction

The construction of the sensor reflects the requirement for reliability and durability. Only the best corrosion resistant materials, such as stainless steels and anodized aluminum are used. The Model 014A sensor uses a quick-connect sensor cable. Cable length may extend hundreds of feet without affecting measurement performance.



Accuracy, reliability and economy make the Model 014A Wind Speed Sensor an ideal choice for most applications.

Specifications

Range	0-100 mph
Starting threshold	1 mph
Accuracy	±.25 mph or 1.5% FS
Distance Constant	
Standard	<15 feet (Metal Cup Assy)
Fast Response	<5 feet (Lexan Cup Assy)
Operating Range	-50° C to +70° C
Contact Rating	10 mA maximum
Weight	11 ounces
Mounting	Model 191 Cross Arm

Ordering Information

Standard Model	014A (Metal Cup)
Fast Response Model	014A-1 (Lexan Cup)
Cable	#1805-xx (xx = length in feet)

Met One Instruments, Inc.

Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

MODEL 014A
WIND SPEED SENSOR

OPERATION MANUAL
Document No. 014A-9800

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

014A WIND SPEED SENSOR

1.0 GENERAL INFORMATION

1.1 The Met One 014A Wind Speed Sensor uses a durable 3-cup anemometer assembly and simple magnet-reed switch assembly to produce a series of contact closures whose frequency Is proportional to wind speed. This sensor Is usually used in conjunction with the 191 Crossarm Assembly and a translator module, but may also be used directly with a variety of dataloggers.

1.2 Sensor Cable has a quick-connect connector with vinyl-jacketed, shielded cable. Cable length is given in -XX feet on each cable part number.

Table 1 - 1
Model 014A Wind Speed Sensor Specifications

Performance Characteristics

Maximum Operating Range	0-60 meters/sec or 0-125 mph
Starting Speed	.5 meters/sec or 1 mph
Calibrated Range	0-50 meters/sec or 0-100
Accuracy	±1.5% or 0.25 mph
Temperature Range	-50° C to 85° C
Distance Constant*	
Standard (1812 Aluminum Cup Assembly)	Less than 15 feet
Optional (1708 Lexan Cup Assembly)	Less than 5 feet

*The distance traveled by the air after a sharp-edged gust has occurred for the anemometer rate to reach 63% of the new speed.

Electrical Characteristics

Output Signal	Contact closure at frequency V= (f x 1.7892) + 1 mph

Physical Characteristics

Weight	1.5 lbs.
Finish	Anodized
Mounting Fixtures	Use with 191 Crossarm
Cabling	2-Conductor Cable, XX is cable length in feet

Optional Accessories
(a)1708 Lexan Cup Assembly, Fast Response Type

2.0 INSTALLATION

2.1 014A Wind Speed Sensor Installation

A. Check to see that the cup assembly rotates freely (threshold, bearing check).

B. Install the sensor into the fitting on the end of the 191 mounting arm. (THE END WITHOUT THE ALIGNMENT BUSHING) Install just deep enough to allow cable connection. (Reference the mounting detail in Figure 2-1).

C. Apply a small amount of silicone grease to the set screws to prevent 'freezing up' in corrosive environments. Tighten the locking set screws--do not over tighten.

D. Connect the Cable Assembly to the connector receptacle on base of sensor. Secure the cable to the mounting arm using cable ties or tape.

2.2 Wiring

The Cable Assembly contains three wires.

Black	=	Signal
Red	=	Common
White/Brn	=	Cable Shield

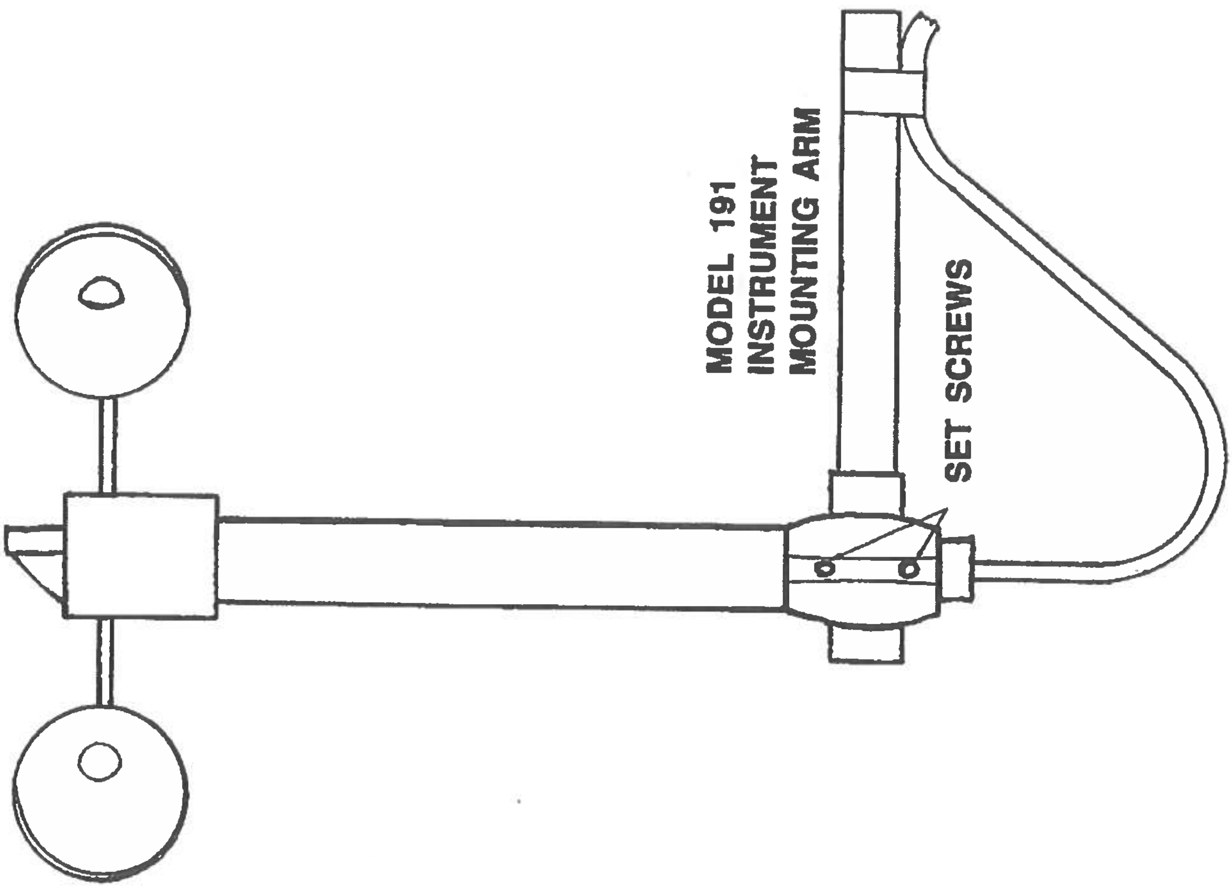


FIGURE 2-1

TABLE 3-1

MODEL 014A WIND SPEED SENSOR CALIBRATION

WIND VELOCITY VS OUTPUT FREQUENCY

Speed in Miles/Hr

V mph	RPS	F hz
10	2.515	5.030
20	5.310	10.619
30	8.104	16.208
40	10.899	21.797
50	13.693	27.386
60	16.488	32.975
70	19.282	38.564
80	22.077	44.153
90	24.871	49.742
100	27.666	55.331
110	30.460	60.920
120	33.255	66.509

SPEED IN METERS/SEC

V mps	RPS	F hz
2.5	1.284	2.567
5	2.846	5.693
7.5	4.409	8.819
10	5.972	11.945
12.5	7.535	15.071
15	9.098	18.197
17.5	10.661	21.323
20	12.224	24.449
22.5	13.787	27.575
25	15.350	30.701
27.5	16.913	33.827
30	18.476	36.953
32.5	20.039	40.079
35	21.602	43.205
37.5	23.165	46.331
40	24.728	49.457
42.5	26.291	52.583
45	27.854	55.709
47.5	29.417	58.835
50	30.980	61.961
52.5	32.543	65.087
55	34.106	68.212
57.5	35.669	71.338
60	37.232	74.464

RPM VS WIND SPEED

RPM	MPS	MPH	F hz
100	3.113	6.964	3.333
200	5.779	12.928	6.667
*300	8.446	18.892	10.000
400	11.112	24.856	13.333
500	13.778	30.820	16.667
*600	16.444	36.785	20.000
700	19.110	42.749	23.333
800	21.777	48.713	26.667
900	24.443	54.670	30.000
1000	27.109	60.641	33.333
1100	29.775	66.605	36.667
1200	32.441	72.569	40.000
1300	35.108	78.533	43.333
1400	37.774	84.497	46.667
1500	40.440	90.461	50.000
1600	43.106	96.426	53.333
1700	45.772	102.390	56.667
*1800	48.438	108.354	60.000

* STANDARD CALIBRATOR TEST POINTS

$$V\ mph = \frac{RPM}{16.767} + 1$$

$$V\ mps = \frac{RPM}{37.5067} + .44704$$

Based on equation f= .5589 (V-1)
where f is the output frequency.
V is wind speed miles per hour.
RPS = cup revolution per second.
1 MPH = 0.44707 meters/sec

3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 014A Wind Speed Sensor Check-Out

A. Spinning the anemometer cup assembly will produce a series of pulses. To verify sensor output, monitor this signal with either a plug-in Translator Module, Datalogger or an Ohmmeter. Refer to Frequency vs. Wind Speed Table 3-1. Spin slowly and monitor output signal. A windspeed calibrator may be used to check operation at different RPM points.

B. Inspect the cup assembly for loose cup arms or other damage. The cup assembly cannot change calibration unless a mechanical part has come loose or has been broken.

4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule*

6-12 month intervals:

A. Inspect sensor for proper operation per Section 3.0.

B. Replace Wind Speed Sensor bearings in extremely adverse environments per Section 4.6.

12-24 month intervals:

A. Replacement of sensor bearings.

24-36 month intervals:

A. Recommended complete factory overhaul of sensor.

*Schedule is based on average to adverse environments.

Table 4-1

TROUBLESHOOTING TABLE

Symptom	Probable Cause	Remedy
No sensor output	Faulty reed switch	Replace reed switch
No sensor ouput	Faulty bearings	Replace bearings
No sensor ouput	Faulty cable	Check Connections

4.3 014A Wind Speed Sensor: 6-12 Month Periodic Service

A. At the crossarm assembly, disconnect the Sensor Cable from the Sensor (leave the cable secured to the crossarm) and remove the Sensor from the fitting on the crossarm assembly.

B. Loosen the two set screws on the side of the hub and remove the anemometer cup assembly.

C. Visually inspect the anemometer cups for cracks and breaks and make sure that each is securely attached to the cup assembly hub.

D. Inspect the Sensor for any signs of corrosion and dust buildup.

E. Rotate the Sensor hub assembly to make sure that it turns freely and that the Sensor bearings are not damaged. Make sure that the magnet assembly is not contacting the reed switch. (Ref. Fig. 4.1).

F. A moisture drain vent is located on the base of the Sensor. Make sure that this vent is clear.

G. Re-install Sensor as per installation procedure (Section 2.0) and verify proper operation using procedures in Section 3.0.

4.4 014A Wind Speed Sensor General Assembly (refer to 014A Assembly Drawing)

The following steps cover basic disassembly:

A. At the crossarm assembly, disconnect the Sensor Cable from the Sensor (leave the cable secured to the crossarm) and remove the Sensor from the crossarm assembly.

B. Loosen the two set screws and remove the anemometer cup assembly.

C. Remove the three (3) flathead screws at the top of the Sensor and lift out the bearing mount assembly, taking care not to break the wires.

4.5 Reed Switch Replacement Procedure

Use the following procedure to replace Sensor Reed Switch:

A. Remove bearing mount assembly as per Section 4.4.

B. Unsolder the leads of the Reed Switch (10) and remove the switch from the two mounting terminals (13).

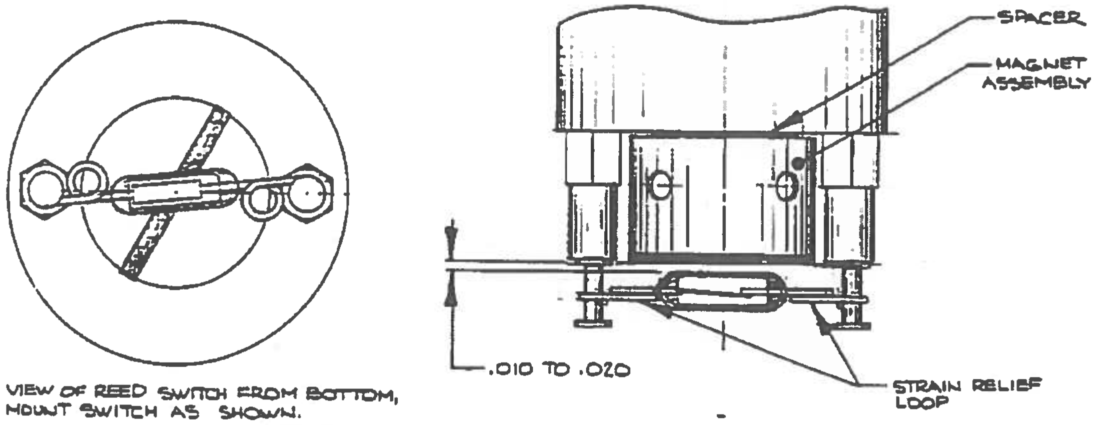
C. Solder the new switch onto the sides on the switch mount terminals, taking care not to stress the point where the leads enter the glass reed switch body. (Solder quickly to reduce excess heat to reed switch.) Measure the distance between the bottom of the rotating magnet and the top of the switch envelope, as shown in Figure 4 -1. The spacing should measure between .010 and .020 inch.

D. Monitor the output of the translator module and spin shaft for an upscale indication. If switch seems to falter, adjust switch slightly closer to magnet.

E. If possible, connect the shaft to an 1800 RPM motor, using a flexible coupling and verify an output of 108 mph with a 50% duty cycle.

F. Reassemble Sensor by reversing procedure.

FIGURE 4-1: REED SWITCH INSTALLATION



4.6 Bearing Replacement Procedures

The bearings used in 014A Sensor are special stainless steel ball bearings with a protective shield. Bearings are lubricated and sealed. Do not lubricate bearings as the lubrication will attract dust and will form an oil/dust glue. Use the following procedure for bearing replacement:

A. Remove bearing mount assembly as per Section 4.4.

B. Loosen set screws(21) in magnet assembly (4), lift shaft (7) and collar (3) up and out of bearing mount (2). Be sure to retain lower spacer (19)

C. Insert a right-angle type of tool, such as an allen wrench into bearing, cock it slightly to one side and remove bearing. Remove both bearings. Clean bearing seats.

D. Install new bearings. Be careful not to introduce dirt particles into bearings. CLEAN HANDS ONLY! DO NOT ADD LUBRICATION OF ANY KIND.

E. Reassemble the Sensor in reverse order. Be sure to include spacers (19) over the bearings when replacing the shaft in the bearing mount. After the magnet assembly (4) has been tightened, a barely perceptible amount of endplay should be felt when the shaft is moved up and down (approximately .004 inch).

4.7 014A Wind Speed Sensor Repair and Recalibration Service

This service provided by the factory enables fast, economical service for the user. This repair and calibration service includes disassembly and detailed electronic components. Service includes replacement of bearings regardless of apparent condition. Service also includes replacement of the following items.

A. Shaft

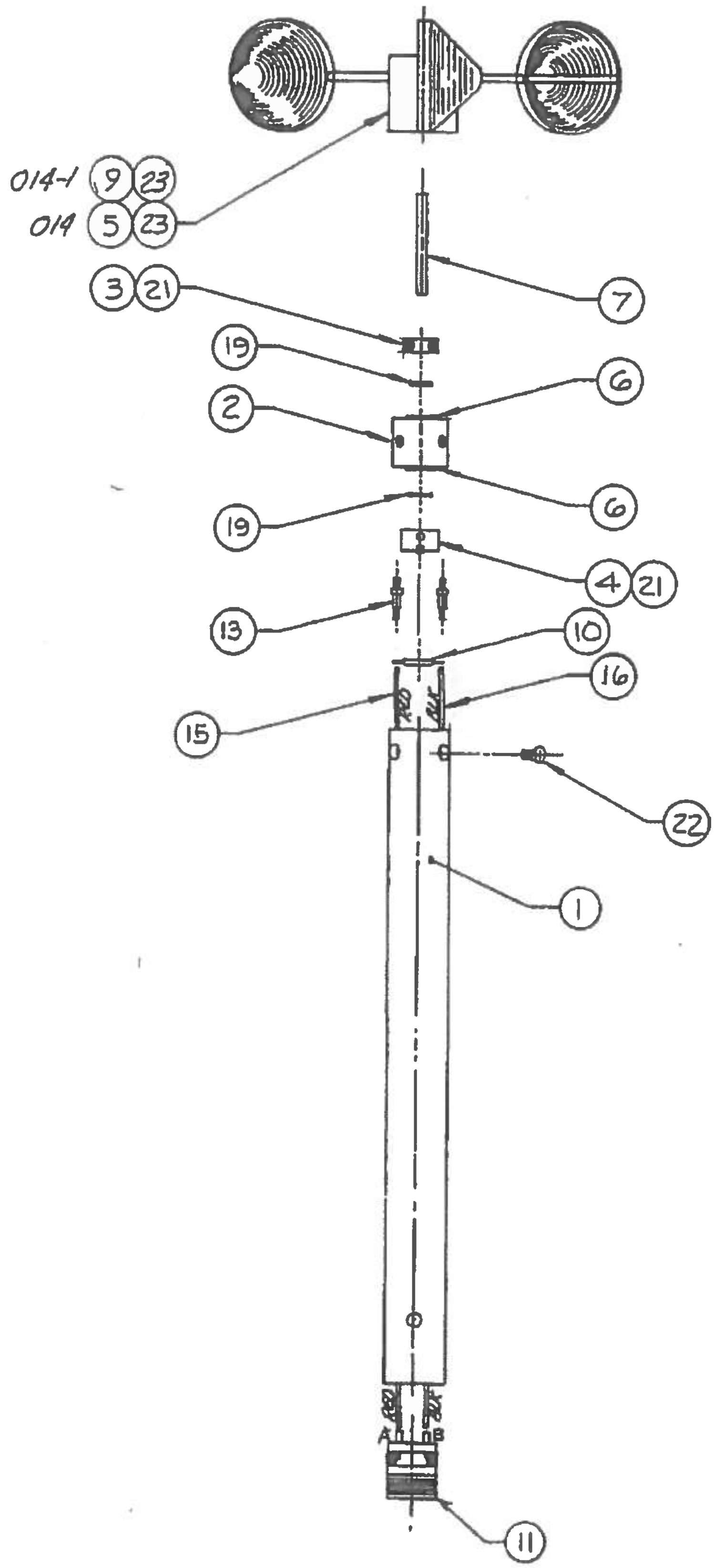
B. All set screws.

Service also includes functional test of Sensor. Other components will be replaced as required. Additional charges for additional materials only will be added to the basic service charge.

Table 4 - 2
REPLACEABLE PARTS LIST

ITEM #	PART #	DESCRIPTION
1	101685-2	WS SUPPORT
2	101685-4	BEARING MOUNT
3 *	101685-7	COLLAR
4 *	101715	MAGNET ASSY
5	101812	CUP ASSEMBLY (ALUM)
6 *	101898	BEARING
7 *	860001	SHAFT
9	101812-1	CUP ASSEMBLY, LEXAN
10 *	2844	SWITCH REED
12	510020	CAP FOR CONNECTOR
13 *	970062	TERMINAL HH SMITH
19 *	860250	SPACER
21 *	601250	SET SCREW 4-40X 1/8
22	601230	FLAT HD. 4-40X 1/4 SCREW

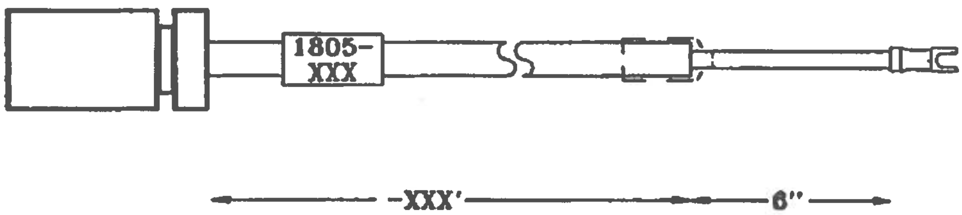
* Parts included in 2402 Rebuild Kit



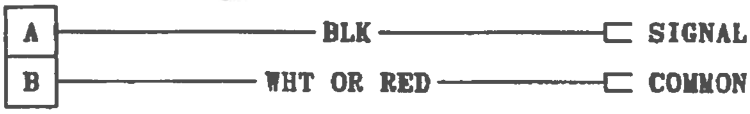
MODEL 014A (-1)
EXPLODED VIEW

0144-9800 REV 9/96

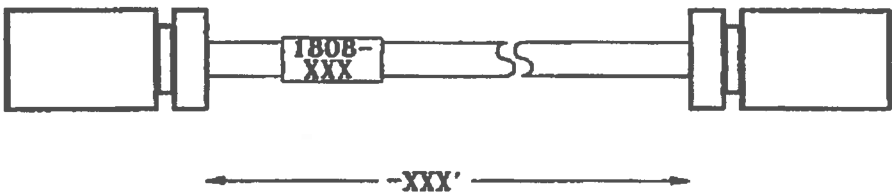
1805 SENSOR CABLE - TERMINATES IN SPADE LUGS



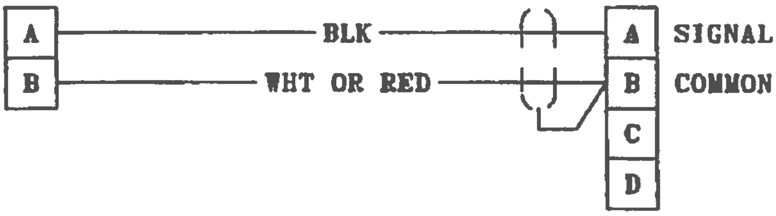
DASH NO. = LENGTH IN FEET



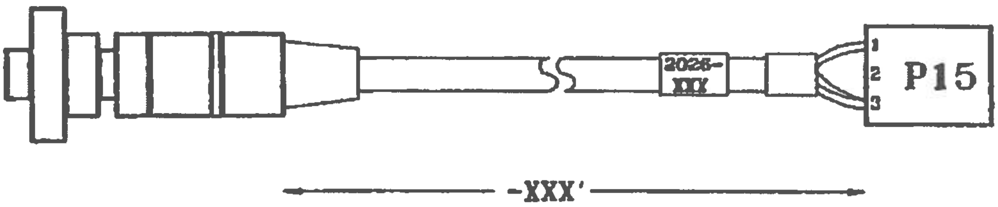
1808 SENSOR CABLE - USE WITH 110 WEATHERPROOF TRANSLATOR



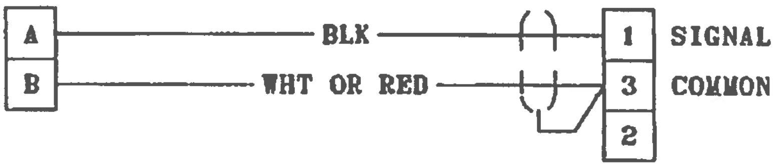
DASH NO. = LENGTH IN FEET



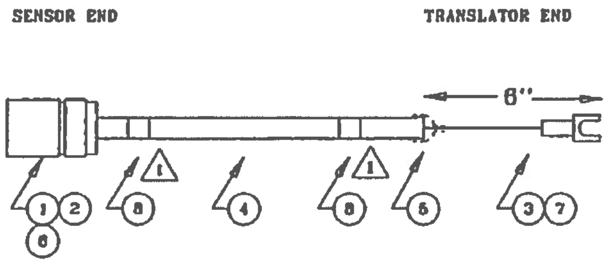
2026 CABLE - USE WITH MET-SET 4B AND 4C



DASH NO. = LENGTH IN FEET



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REDRAWN PER E.O. 1131	9/11/91	DH



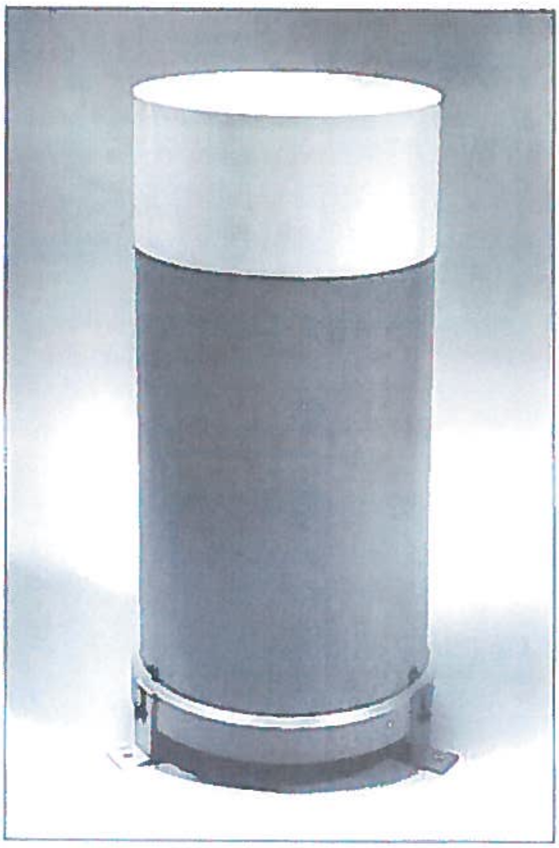
ITEM	PART NO.	DESCRIPTION	QTY
1	500372	CONNECTOR, 2 PIN , MS3106A-14S-2S	1
2	480500	CLAMP	1
3	600193	LUG, SPADE, #6	3
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

SOLDER CUP VIEW

1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

MET ONE INSTRUMENTS	
ASSY, CABLE, 014 WIND SPEED SENSOR	
SIZE	FSCM NO.	DWG NO. 1805	REV D
SCALE	SHEET 1 OF 1

Precipitation Gauges



The Model 370 Raingauge

The accurate measurement of rain and snow precipitation remains one of the most basic elements of meteorology. To enable accurate measurement of precipitation in all environments, Met One Instruments provides a series of instruments incorporating a tipping bucket mechanism. The tipping bucket design allows accurate, repeatable measurements, requires no regular operator maintenance, and is economical and proven in operation.

Features

- Jeweled bearings
- Teflon coated bucket
- Reed switch
- Self emptying
- Corrosion resistant materials
- Quality construction

Each model in the series is optimized to meet a particular site and sampling requirement.

Operation

A dual-chambered tipping bucket assembly is located below the collection funnel. When a precise amount of precipitation has been collected in one side of the bucket, gravity tips the assembly and activates a reed switch. A momentary electrical contact closure through the switch is provided for each increment of rainfall. The sample is discharged through the base of the gauge.

For environments that can typically expect a significant amount of frozen precipitation, internal sensor heaters are available. The heating elements are thermostatically controlled to melt and measure the water content of snow and frozen rain, but to avoid evaporative loss.

Construction

The heavy machined aluminum base provides a stable platform for the tipping assembly. The bucket is made from stainless steel and is Teflon coated to prevent retention of the sample. The bucket pivots are precision machined and fitted with jeweled bearings to reduce wear and friction. The funnel is powder coated aluminum and has two screens for preventing leaves and other debris from entering or clogging the gauge. A circular bubble-level and adjustable feet facilitate proper mounting of the unit. Major components are finished in catalyzed polyurethane paint, with a color and texture chosen to allow the sensor to blend into the environment.

Met One Instruments, Inc.
Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

Specifications

Rain Gauges

Model No.	Funnel Dia.	Standard Calib.	Optional Calib.
370	8"	0.01"	0.2 mm or 0.25 mm
372	8"	0.5 mm	N/A
380	12"	0.01"	0.2 mm or 0.25 mm
382	12"	0.1 mm	N/A

Rain & Snow Gauges

Model No.	Funnel Dia.	Standard Calib.	Optional Calib.	Heater Voltage
375	8"	0.01"	0.2 mm or 0.25 mm	115 VAC
376	8"	0.01"	0.2 mm or 0.25 mm	220 VAC
377	8"	0.5 mm	N/A	115 VAC
379	8"	0.5 mm	N/A	220 VAC
385	12"	0.01"	0.2 mm or 0.25 mm	115 VAC
386	12"	0.01"	0.2 mm or 0.25 mm	220 VAC
387	12"	0.1 mm	N/A	115 VAC
389	12"	0.1 mm	N/A	220 VAC

Accuracy	at 0.5"/hour	±0.5%
	at 1" to 3"/hour	±1.0%
Switch	Type	Reed
	Rating	10 mA, 28 VDC
Height	8" Gauges	18" (46 cm)
	12" Gauges	20.5" (52 cm)

Weight	8" Rain Gauges	6 lbs. (2.7 kg)
(not including cabling)	12" Rain Gauges	7.5 lbs. (3.4 kg)
	8" Rain & Snow Gauges	6.5 lbs. (3 kg)
	12" Rain & Snow Gauges	11.5 lbs. (5.2 kg)
Shipping Weight	8" Rain Gauges	8.5 lbs. (3.9 kg)
(not including cabling)	12" Rain Gauges	10 lbs. (4.5 kg)
	8" Rain & Snow Gauges	9 lbs. (4 kg)
	12" Rain & Snow Gauges	14 lbs. (6.4 kg

Finish White Gloss/Biege textured powder coat and clear anodized aluminum

Cable	Signal	#1566-xx
	Power (as req'd)	#2517-xx
		(xx = length in feet)

Ordering Information

Specify Model number, calibration factor, cable length(s), and accessories.

Accessories and Related Products

Model 820440 Wind Screen. The improved Alter-design screen is constructed of 32 free-swinging, separated leaves. It can greatly improve the accuracy of the precipitation catch by reducing local turbulence.
Model 550500 Evaporation Gauge. This device measures the water level in a standard evaporation pan, and provides an output proportional to that level.

Please contact Met One Instruments for additional information on these products.

Specifications subject to change.

MODEL 375C
8" RAIN GAUGE

OPERATION MANUAL
Document No. 375-9801

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 503-471-7111
Facsimile 503-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 214-412-4747
Facsimile 214-412-4716

MODEL 375C
ELECTRIC RAIN/SNOW SENSOR
OPERATION MANUAL

1.0 GENERAL INFORMATION

1.1 Model 375C Electric Heated Tipping Bucket Rain/Snow Gauge is an accurate, sensitive and low-maintenance sensor designed to measure rainfall on a continuous basis. Water does not collect in the sensor, but is drained each time an internal bucket fills with 0.01 inch of rainfall (standard calibration). At this time, a switch closure pulse is also sent to the translator module for counting. The sensor is calibrated prior to shipment and requires no adjustments after mounting.

1.2 Sensor Cable is a vinyl-jacketed 2-conductor shielded cable connecting to the sensor via an internal terminal strip. Cable length is designated in -xx feet on each cable part number label.

1.3 Power Cable is a vinyl-jacketed 3-conductor shielded cable connecting to the sensor heaters with wire nuts in an externally mounted J-Box. Cable length is designated in -xx feet on each cable part number label.

Table 1-1
Model 375C Rainfall Sensor Specifications

Orifice	8" Diameter
Calibration (standard) Calibration (options)	.01" Rain per switch closure 0.2mm, 0.25mm
Accuracy	±1% at 1" to 3" per hour at 70° F
Switch Type	Magnet & Reed
Mounting	3 Pads for 1/4 bolts on 9-21/32" (9.66") circle diameter
Dimensions	17-3/4" high, 8" diameter not including mounting pads
Power Requirement	110VAC, 50/60 Hz, 315W
Weight, less cables	7.5 lbs/3.4 kg (10 lbs shipping w/cables)

2.0 INSTALLATION

2.1 Choose a site where the height of any nearby trees or other objects above the sensor is no more than about twice their distance from the sensor. (Sample: 50 ft tree at least 100' away from gauge). A uniform surrounding of objects (such as an orchard) is beneficial as a wind break. Nonuniform surroundings (such as a nearby building) creates turbulence which affects accuracy.

2.2 Mount the sensor level on a platform, using the built in level as an aid. The three legs can be adjusted for leveling. Three 1/4" diameter bolts are used to mount the sensor on a 9-21/32" (9.66") bolt circle.

2.3 Remove shipping restraint (This may be tape, rubber band, or similar item) from sensor bucket and verify that bucket moves freely and that all adjusting screws are tight.

2.4 Connect the signal cable lugs to the terminal strip if not connected already. See diagram. Polarity is not important. See FIGURE 2-1.

2.5 Connect the power cable to the leads inside the condulet (see FIGURE 2-2) if not connected already.

2.6 Replace cover on sensor, tightening screws at base.

NOTE: If snowfall is anticipated, remove primary screen from funnel.

2.7 Route signal cable to the translator or datalogger and connect. Refer to the System Interconnect Diagram in your system manual for terminal identification.

2.8 Route the power cable to a 110VAC power source protected with a 15A GFI circuit. Connect (Ref. FIGURE 2-2). This wiring must conform to local and state wiring codes. If you are not familiar with these codes, an electrical contractor should be used.

Warning:
As with any AC power wiring, improper safety procedures can cause fatal injuries. If you are not qualified to do this work, call an electrical contractor to do it for you.

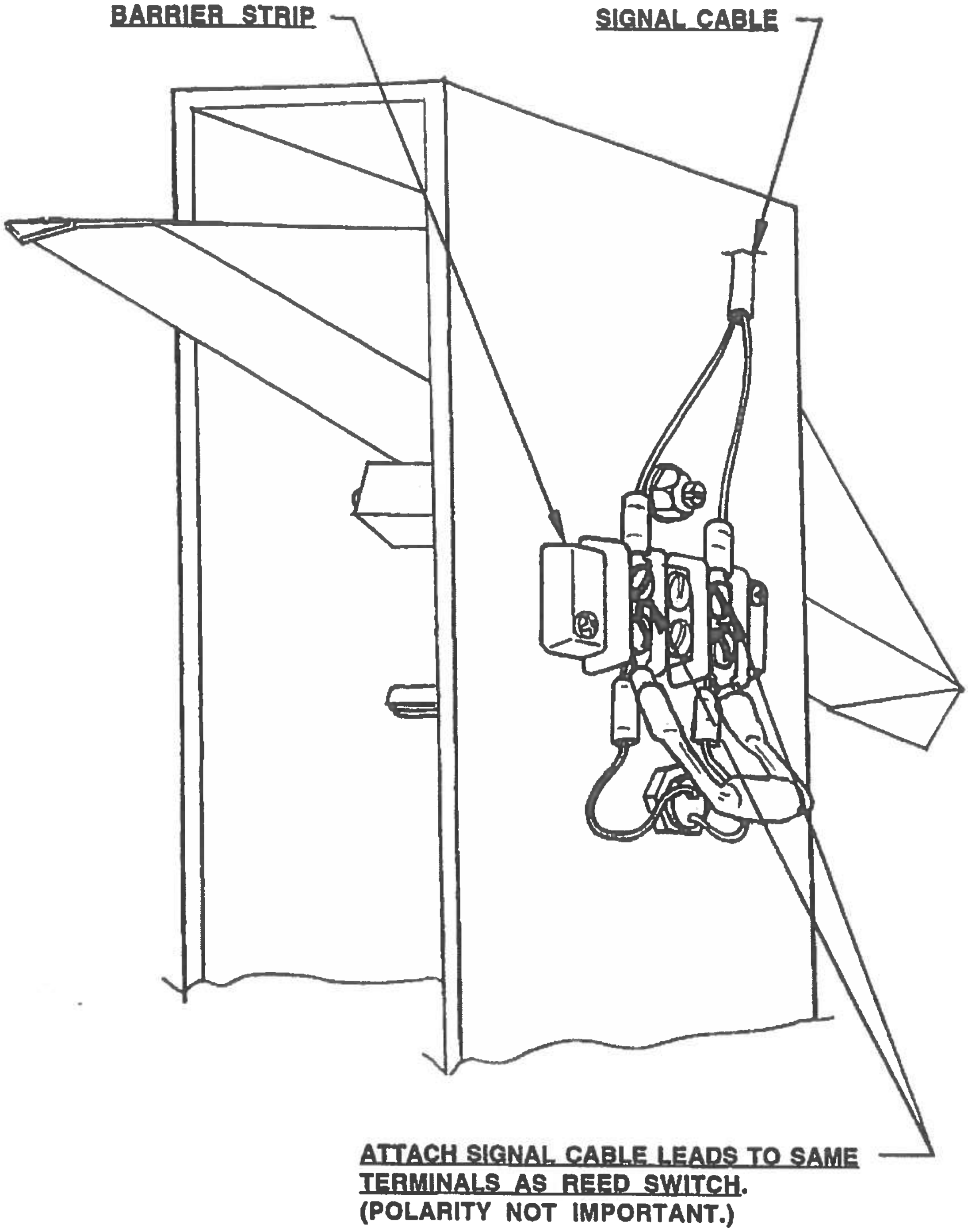
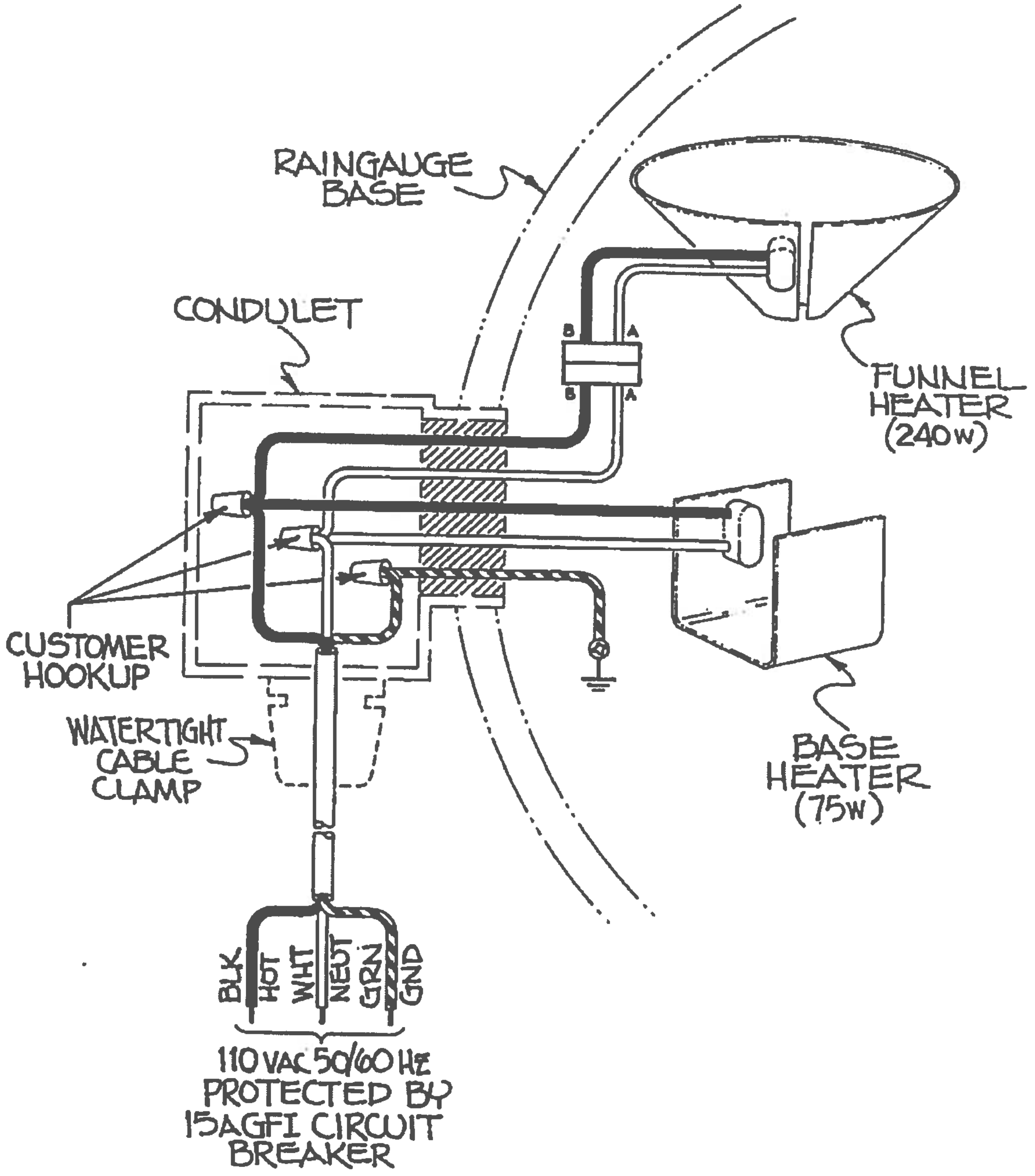

BARRIER STRIP
SIGNAL CABLE
ATTACH SIGNAL CABLE LEADS TO SAME
TERMINALS AS REED SWITCH.
(POLARITY NOT IMPORTANT.)

FIGURE 2-1



HEATER POWER HOOKUP

FIG. 2-2

3.0 OPERATIONAL CHECK-OUT

3.1 Manually actuate tip bucket mechanism (stop-to-stop) three (3) times. Confirm that 3 tips have registered on the recording equipment. If not, refer to Troubleshooting Guide, Section 4-3.

4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule*:
At six month intervals, perform the following steps:

a. Clean sensor funnel and buckets.
b. Do NOT lubricate the pivots, as any lubricant may attract dust and dirt and cause wear of the jewel bearings.
c. Verify that buckets move freely and that translator card or datalogger registers 0.01" or as calibrated for each bucket tip.

*Based on average to adverse environments.

4.2 Calibration. The sensor is factory calibrated; recalibration is not required unless damage has occurred or the adjustment screws have loosened. To check or recalibrate, perform the following steps:

a. Check to be sure the sensor is level.

b. Wet the mechanism and tipping bucket assembly. Using a graduated cylinder, slowly pour the measured quantity of water through the inner funnel to the tipping bucket, which should then tip. Repeat for the alternate bucket. If both buckets tip when filled with the measured quantity of water, the sensor is properly calibrated. If they do not, recalibrate as follows:

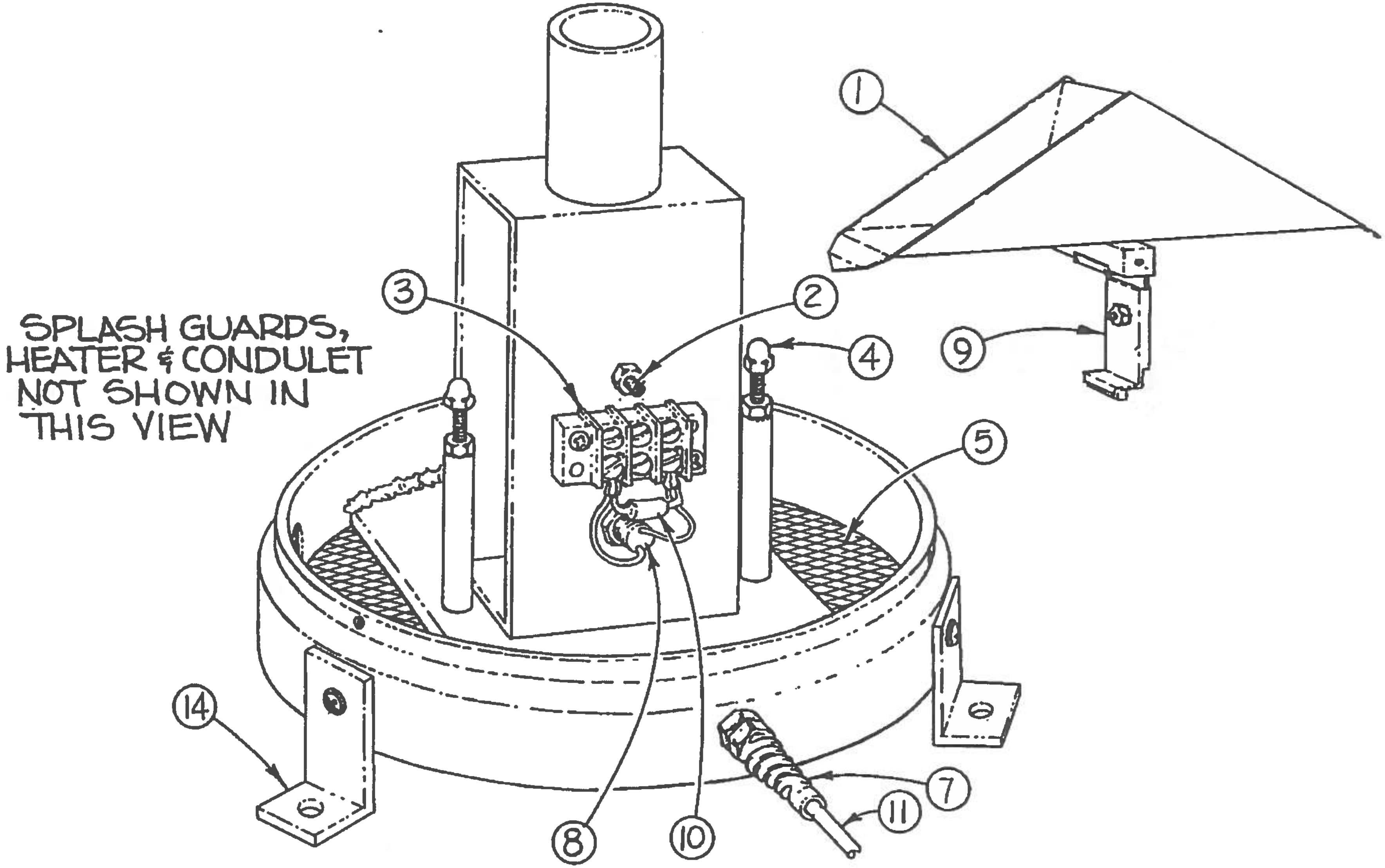
1. Release the lock nuts on the cup adjustments.
2. Move the adjustment screws down to a position that would place the bucket far out of calibration.
3. Allow the measured quantity of water to enter the bucket. (Refer to Table 4.1)
4. Turn the cup adjustment screw up until the bucket assembly tips. Tighten the lock nut.
5. Repeat steps 3 and 4 for the opposite bucket.
6. Measure the quantity of water necessary to tip each bucket several times to ensure proper calibration.
7. Replace the cover on the gauge.

Table 4.1
Calibration Quantities

Tip Calibration	Water Quantity
0.01" (standard)	8.24 milliliters
0.2mm	6.49 milliliters
0.25mm	8.11 milliliters

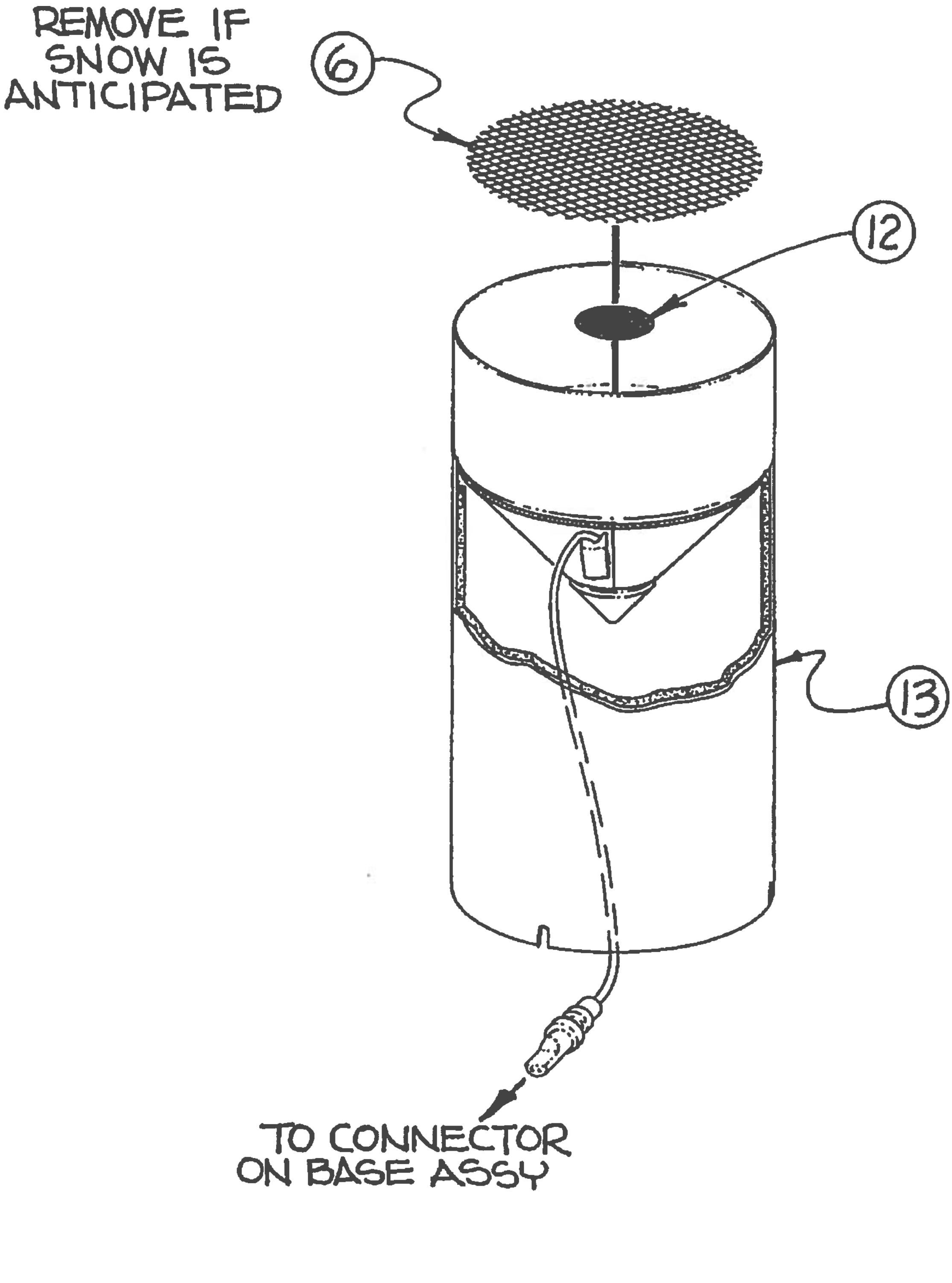
4.3 TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
No sensor output	Faulty Reed Switch	Replace Reed Switch
	Signal Cable Connection	Check Connections
	Lightning Strike	Replace Reed Switch & Diode
	Debris in Funnel	Clean (See 4.1)
Erroneous Reading	Sensor not level	Re-level
	Sensor out of Calibration	Recalibrate (see 4.2)
	Site too near trees or other objects	Relocate (See 2.1)
Snow Not Melting	Heaters not getting power	Check circuit protector (customer provided)
	Heater Failure	Return unit to factory for repair.
	Primary Screen Installed	Remove Screen



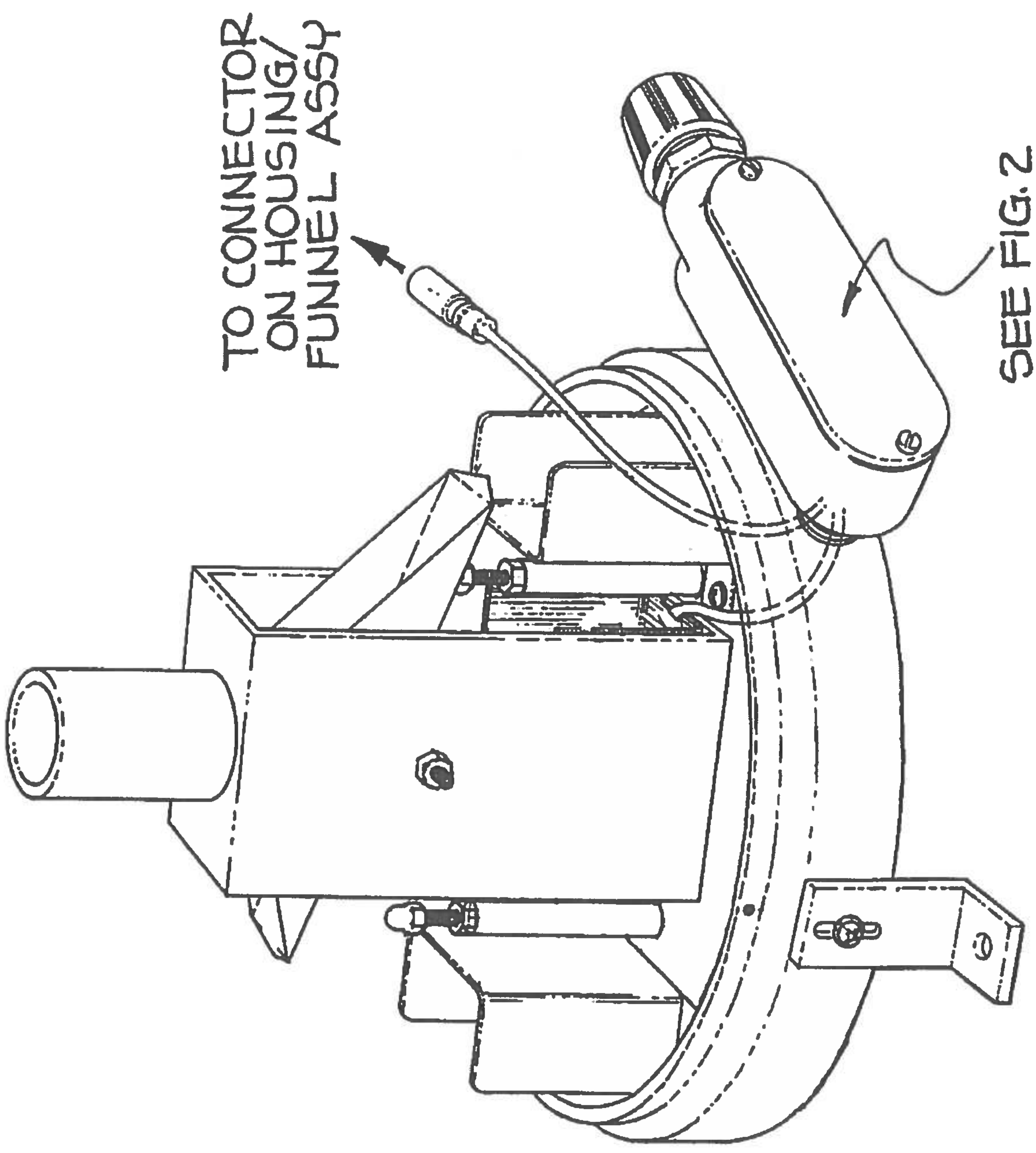
BASE ASSEMBLY

FIGURE 4-1



HOUSING/FUNNEL ASSEMBLY

FIGURE 4-3



BASE ASSEMBLY
(SHOWING HEATER COMPONENTS)

4.4 REPLACEABLE PARTS LIST

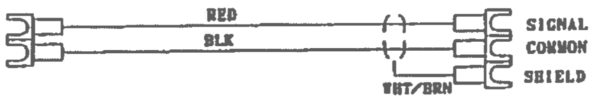
Model 375C Rain Gauge Parts List

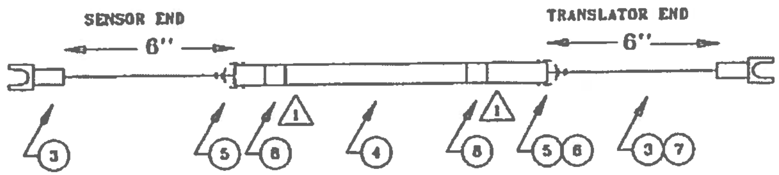
I.D. No.	Part No.	Description
1	2545	Assembly, Tip Bucket (.01", .2mm, .25mm)
2	2492	Pin, Pivot
3	340070	Barrier, Strip - 3 pos.
4	480210	Nut, Crown, Nylon #8-32
5	2598	Screen, Base
6	2503	Screen, Primary Top
7	480510	Clamp, Liquid-Tight
8	2934	Reed Switch Cartridge
9	2936	Adjustable Magnet Bracket
10	2937	Lightning Protection Diode
11	1566	Standard Cable Assembly
11	2745	Cable Assembly (for use with Automet)
12	2504	Screen, Secondary
13	2666	Assembly, Housing/Funnel 8" (115VAC)
14	2516	Foot

4.5 REPAIR AND RECALIBRATION SERVICE

This service provided by Met One Instruments enables fast, economical service for the user. This repair and calibration service includes disassembly, inspection, cleaning, reassembly and calibration. Components will be replaced as required. Additional charges for additional materials only will be added to the basic service charge.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REDRAWN W/PARTS LIST	9/16/91	DB





1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

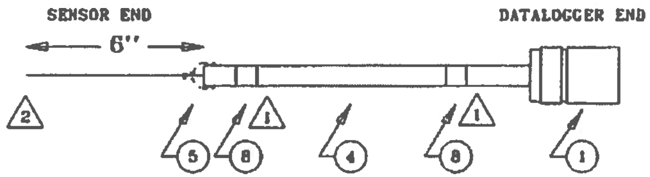
ITEM	PART NO.	DESCRIPTION	QTY
1			
2			
3	600193	LUG, SPADE, #6	5
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6			
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

MET ONE INSTRUMENTS

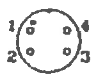
ASSY, CABLE, RAIN GAUGE

SIZE	FSCM NO.	DWG NO. 1566	REV C
SCALE		SHEET 1 OF 1	

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
N/C	PROD REL	8/3/94	DH



1. IDENTIFY CABLE 18" FROM EACH END. DASH NUMBER = LENGTH IN FEET. STANDARD LENGTH = 50 FT
2. STRIP AND TIN WIRE ENDS 1/4"



SOLDER CUP VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	500102	CONNECTOR, 4 PIN, FEMALE	1
2			
3			
4	400010	CABLE, 2 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6			
7			
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

MET ONE INSTRUMENTS			
ASSY, CABLE, RAIN GAUGE			
SIZE	FSCM NO.	DWG NO. 2745	REV N/C
SCALE		SHEET 1 OF 1	

Barometric Pressure Sensors

090D
091

Barometric Pressure Sensors convert absolute atmospheric pressure into a linear, proportional voltage, which may be used in any meteorological program.

Features

- Compact size
- Weatherproof enclosure
- Remote output
- Permanent calibration
- Robust construction

These sensors are inherently stable devices that do not require periodic service or routine recalibration.

Operation

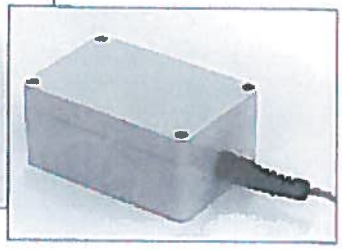
The enclosure houses a solid-state pressure transducer, with linearization and amplification electronics.

The Model 090D is housed in a heavy duty fiberglass enclosure, suitable for harsh and severe environments. A hose barb is provided to enable the connection of a 1/4" sampling tube to the outside environment.

The Model 091 is contained within a small polycarbonate enclosure, and may be mounted outside or inside a building or other enclosure. Small inlet holes allow the atmospheric pressure access to the sensing element.

The standard range of the 090D/ 091 is 26-32 in. Hg,* suitable for elevations sea level to 1500 ft. Other ranges are available.

090D



091

Specifications

Performance

Resolution	Infinite
Temp Operating Range	-40°C to 65°C
Temp Compensated Range	-18°C to 65°C
Accuracy	±0.04 in Hg (±1.35 mbar) or ±0.125% FS

Electrical Characteristics

Power Requirement	11 mA @ 12 VDC, Typical
Sensor Output	0-1 VDC Standard 0-5 VDC Optional

Physical Characteristics

Weight, 090D	2 lbs 5 oz (1.05 Kg)
Dimensions, 090D	5.5" x 5" x 7.5" (14x12x19 cm)
Weight, 091	8.8 oz. (250 g)
Dimensions, 091	2.13" x 3.2" x 5" (5.4x8.3x13 cm)

Ordering Information

	Specify elevation
	Specify output voltage
Cable	#1169-xx (xx = length in feet)
	Specify length in feet

Specifications subject to change without notice.
*Conversions: 1 in. Hg = 3.3864 kPa, 1 in. Hg = 33.864 mbar, 1 in. Hg = 25.4 mm/Hg

Met One Instruments, Inc.
Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

MODEL 091
BAROMETRIC PRESSURE SENSOR

OPERATION MANUAL
Document No. 091-9800

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

Barometric Pressure Sensor Model 091
Operation Manual

1.0 GENERAL INFORMATION

1.1 091 Barometric Pressure Sensor uses an active solid-state device to sense barometric pressure. Self-contained electronics provide a regulated voltage to the solid state sensor and amplification for the signal output.

1.2 A 1169-XX' Sensor Cable is a 4-conductor shielded, vinyl jacketed cable. Length is given in -XX feet on each cable part number label.

TABLE 1-1

Model 091 Pressure Sensor Specifications

Performance

Calibrated Range	26-32" (standard)*
Calibrated Operating Range	-18°C to +50°C
Operating temperature range	-40°C to +50°C
Resolution	Infinite
Accuracy	±0.04 in Hg (±1.35 mb) or
Accuracy	±0.125% FS
Output	0-1V DC (standard)*

*Refer to model number of sensor. Example: 091 - 26/32 - 1

Basic Mod # Range ("Hg) Output Voltage

(In this example, the sensor output is 0-1v for a range of 26 to 32" Hg)

Electrical Characteristics

Power Requirement	11 ma @ 12 VDC
Sensor Output	0-1 VDC Standard
	0-5 VDC Optional

Physical Characteristics

Weight	8.8 oz (250 g)
Dimensions	2.13" x 3.2" x 5" (5.4x8.3x13 cm)

2.0 INSTALLATION

2.1 Mounting the Sensor. Mount sensor in a convenient location with pressure inlet port facing downward.

2.2 Installing the Cable. The 1169 Cable Assembly contains four wires. Install the cable into the water-tight gland and connect cable as follows:

SIG = Signal Output (Wht)
COM = Signal Common (Grn)
+12 = +12V Power (Red)
COM = Power Com (Blk)

3.0 OPERATION

3.1 The Barometric Pressure Sensor has been calibrated at the factory, and will not change unless it is damaged. To check for proper operation of the sensor and module, it is advised that the module's output be checked against a local weather service facility. Exact correlation is not to be expected, due to geographical and meteorological variations. The sensor reads absolute barometric pressure, whereas local weather services readings are normalized to sea level values.

3.2 One should keep in mind that nominal pressure, at sea level, is 30 inches of mercury and that for every 1,000 feet of elevation, the pressure decreases approximately one inch of mercury. EXAMPLE: A weather station at sea level may use a barometer with a range of 26 to 32 inches of mercury to cover all possible weather conditions. However, a weather station, located 4,000 above sea level, would require a range of 22 to 28 inches of mercury.

MODEL 091 BAROMETRIC PRESSURE SENSOR
RANGE SELECTION GUIDE

ELEVATION	RANGE ("Hg)
0 to 1,500	26/32
1,501 to 3,500	24/30
3,501 to 5,500	22/28
5,501 to 8,000	20/26
8,001 to 10,000	18/24
10,001 to 12,500	16/22
12,501 to 15,500	14/20
15,501 to 19,000	12/18

3.3 Each sensor is provided with a calibration data sheet showing transducer outputs at two or more pressure levels. It is important to record these values, as they are required, should it ever be necessary to recalibrate the pressure translator module in the field. If these values are lost, the sensor can be returned to the factory for recalibration.

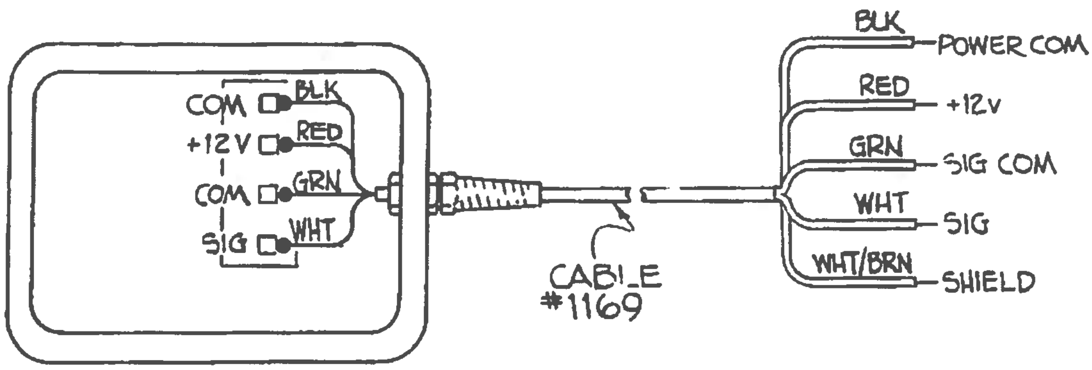
4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule.

A. Inspect pressure inlet port occasionally to insure it is free of obstruction. No other periodic maintenance or calibration is required.

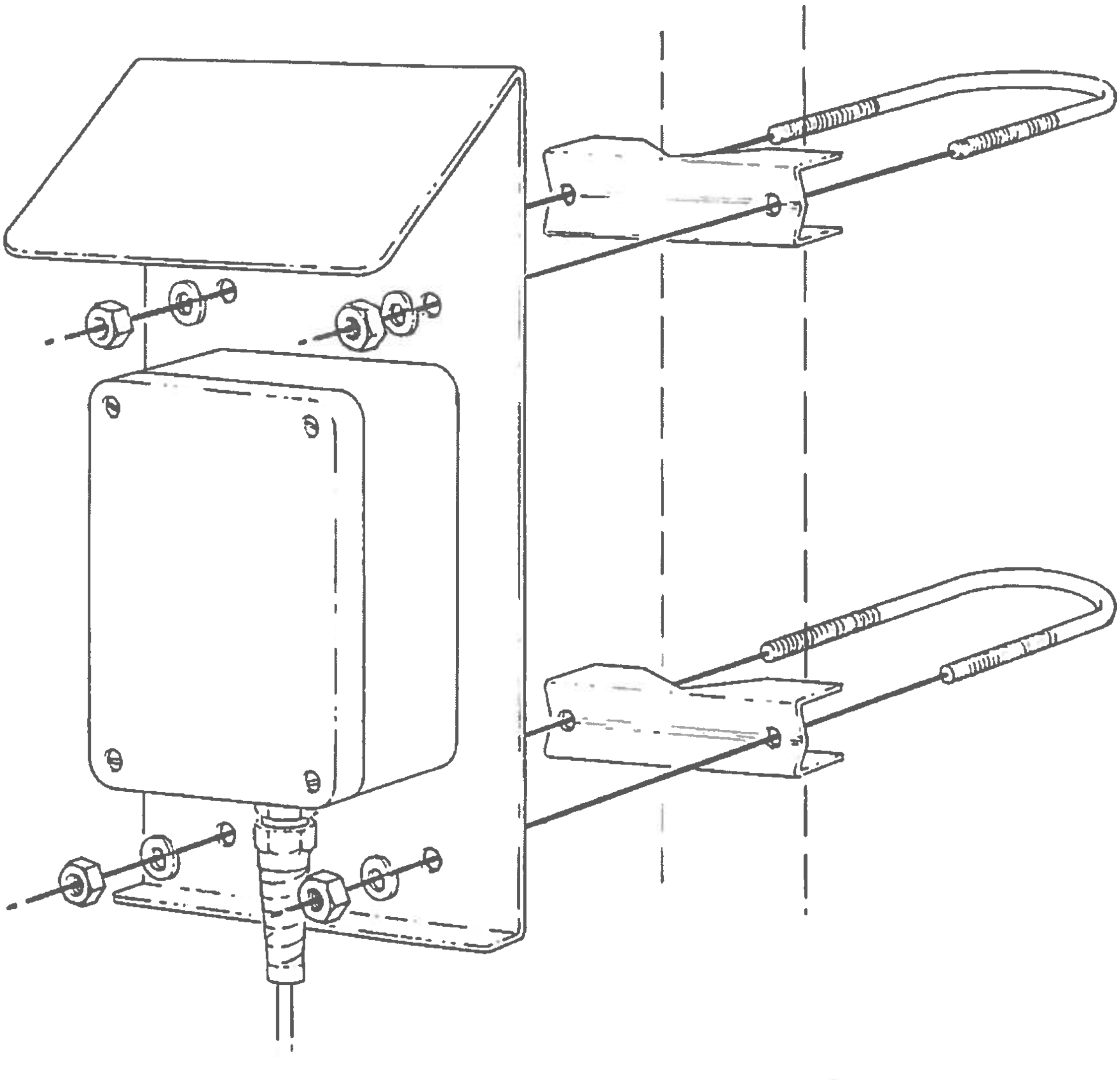
B. Inspect sensor for proper operation per Section 3.1.

4.2 091 Pressure Sensor Maintenance. The pressure sensor is an inherently stable device that does not require periodic service or recalibration. Should service or recalibration become necessary, the sensor must be returned to the factory. Always inspect Model 091 Pressure Sensor to make sure that inlet port is clean and free from obstructions.

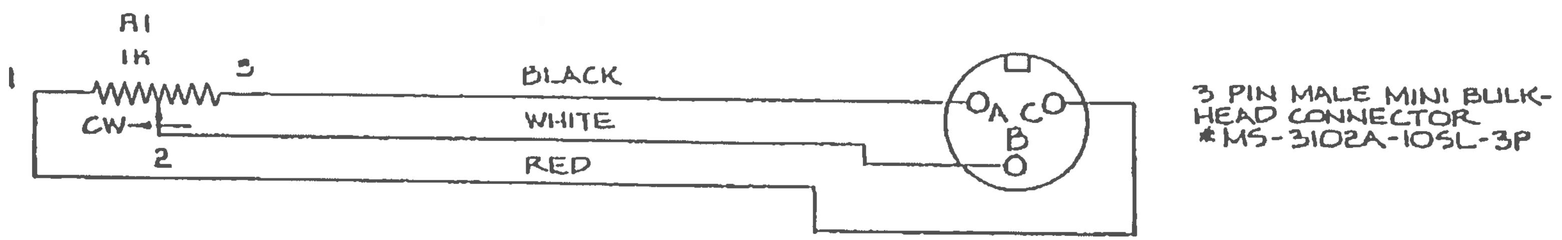


MODEL 091 BAROMETRIC PRESSURE SENSOR
CABLE CONNECTIONS

(See Section 2.2)



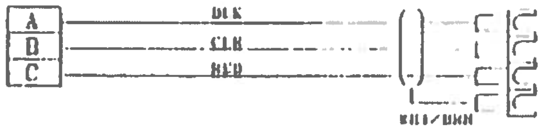
MODEL 091 MOUNTING DETAIL

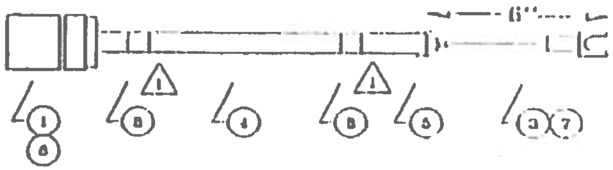


NOTE:
CLOCKWISE DIRECTION INDICATED IS FOR GEAR BOX MOUNTED POTENTIOMETER

INTERNAL WIRING DIAGRAM

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	PROD REL - REDRAWN	12/2/93	DH





ITEM	PART NO.	DESCRIPTION	QTY
1	SEE NOTE	CONNECTOR, 3 PIN, MS	
2			
3	800103	LUG, SPADE, #8	4
4	400011	CABLE, 3 COND, W/SHIELD	A/R
5	880050	SLEEVING, 1/4", SHRINK	A/R
6	860075	SLEEVING, 1/8", SHRINK	A/R
7	880510	WIRE, 22 AWG, WHT/BRN	6"
8	880060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

NOTE: CONNECTOR SUPPLIED WITH EVAP GAUGE 550502

⚠1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

MET ONE INSTRUMENTS			
ASSY, CABLE, EVAPORATION GAUGE			
SIZE	FSCM NO	DWG NO 5883	REV A
SCALE		SHEET 1 OF 1	

Towers and Tripods

All meteorological systems need a means of raising the sensors to the required elevation above ground level. The standard reference point is ten meters, or approximately 33 feet; however, measurements are frequently required at any elevation from a few feet to several hundred feet. Met One Instruments meets this need with a full line of towers, tripods, and instrument lift systems.

Standard Stacked Towers

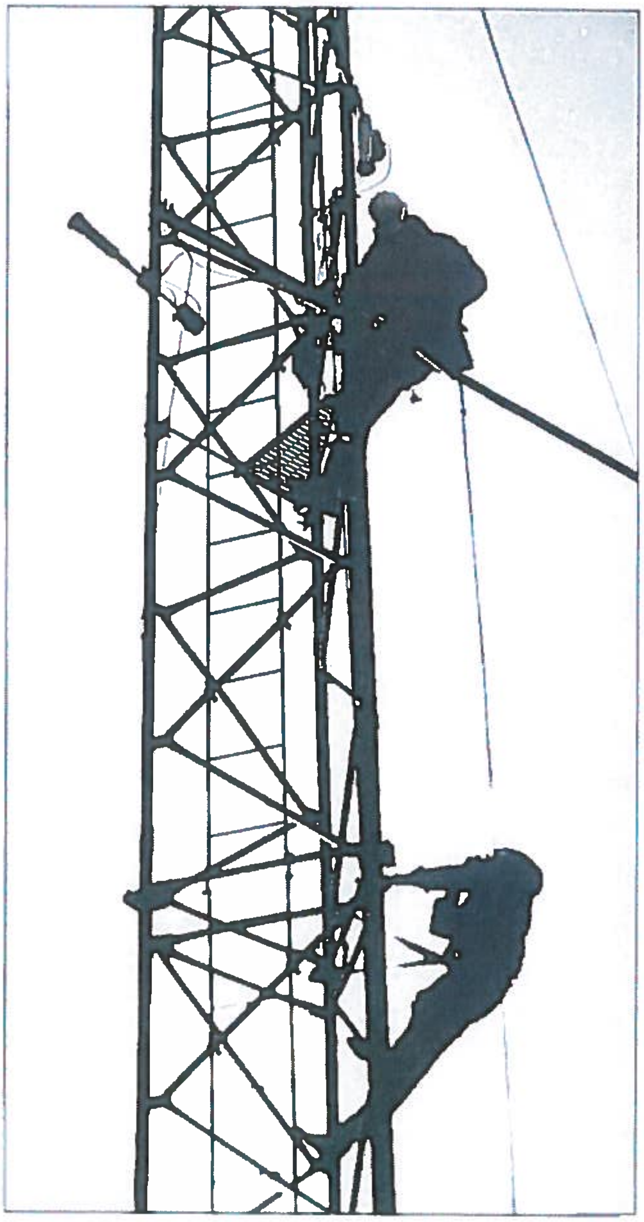
Standard stacked towers are built on a 12" equilateral triangle of 1" steel tubing with electrically welded, continuous steel "zig-zag" cross bracing. This design results in a structure that is at least one-third stronger than competing towers. All sections are hot-dipped galvanized after fabrication for corrosion protection. Individual 10-foot sections are light weight (31 pounds), and are easily connected to each other using double-bolted leg joints. Most installations use guying cables to anchors located at a distance of 80% of the tower height. However, the structure is strong enough to be self-supporting using a house bracket. Several base configurations are available, incorporating a concrete foundation.

Model 970664 40' guyed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A pier pin is provided which must be located within the foundation. The base of the tower fits over the projecting pin to locate the tower and prevent the base from moving off the foundation. Complete guying materials are provided, including a bracket assembly for the tower, guy cables, turnbuckles, clamps, thimbles, etc. Three anchor rods for guy points are provided, each of which requires a poured concrete foundation. Grounding rods are provided for the tower and each guy point.

Model 970668 40' guyed tower

This tower is identical to Model 970664, except that screw-in anchors are provided for the guy points in place of the poured foundation style.



Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

Model 970666 30' guyed fold-over tower

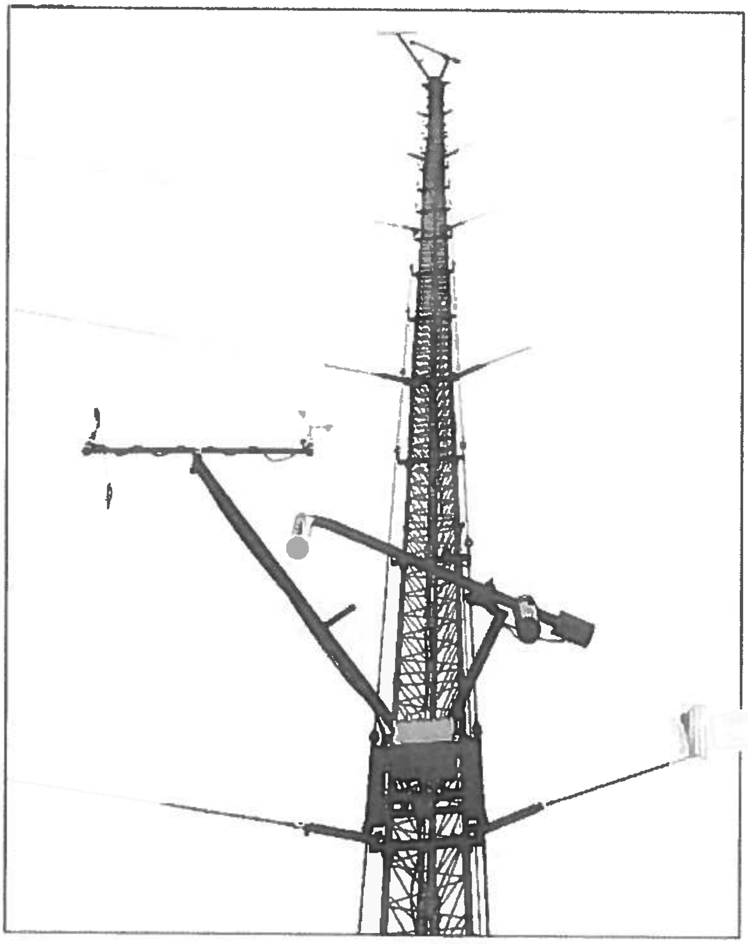
This tower hinges at approximately 10 feet above ground level, allowing the instrumentation mounted on the tower to be serviced from ground level. One special foldover section, one standard 10 foot section, and a tapered top section are provided. A winch mechanism and cabling are included to activate the tilt mechanism. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Four screw anchors to provide guy points to the hinge level are included. Complete guying materials, including guy cables, turnbuckles, clamps, thimbles, etc. are provided. Grounding rods are provided for the tower and each guy point.

Model 970667 40' guyed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Three screw anchors to provide guy points are included Complete guying materials, including guy cables, turnbuckles, clamps, thimbles, etc. are provided. Grounding rods are provided for the tower and each guy point.

Model 970665 40' bracketed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Brackets are provided to support the tower to an adjacent building, eliminating the need for guy cables and anchors. Grounding rod is provided for the tower.



Typical Tall Tower and Instrumentation

Aluminum Towers

Aluminum alloy towers have the advantage of lightness of weight which makes relocation from site to site easier. They are also often used in mobile operations, such as on van or trailer mounted monitoring stations.

Model 970894 33 Foot aluminum tower, guys suggested but not required

Tapered top section with 11" leg width, straight center section, 11" width, Lower section with 14" leg width (reducing to 11"). Height to make 10 meters is provided by mast extension. Steel base suitable for imbedding included. Guy kit will be provided to suit requirements.

Model 305831 35 foot telescoping aluminum tower

A light weight tower composed of 3 nested aluminum sections. An integrated winch is used to raise and lower the sections. Guy wires, turnbuckles, cable clamps, etc. are furnished to guy each section, and duckbill ground anchors are provided. The tower is crated for shipment. An optional power winch is available in either 110 VAC or 12 vdc.

Tower Options

#5284 Tower grounding system

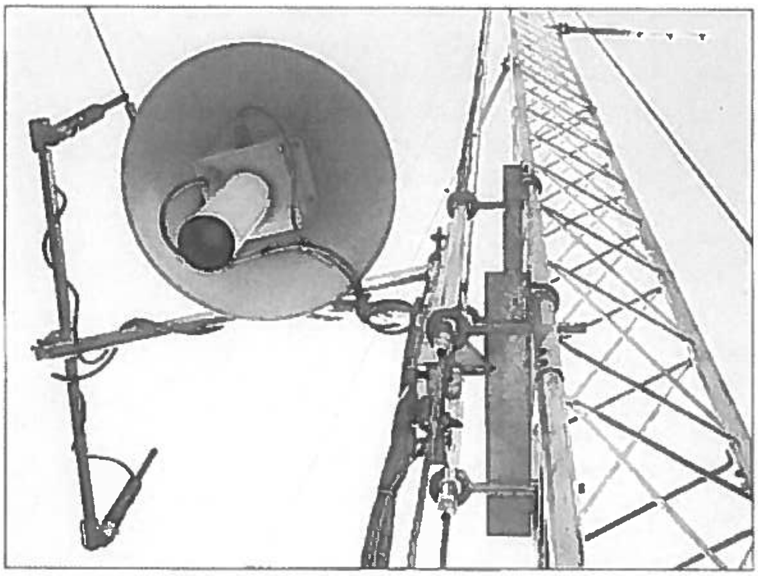
The Model 5284 includes all materials required to provide lightning protection to the tower. An air terminal with 5' extension rod, braided 2-0 copper cable, ground rod, and all clamps are provided.

#2420 Instrument boom

The Model 2420 includes two special cross fittings and a five-foot long, 3/4" IPS aluminum boom. The Model 2420 allows the boom to mount to the side of any tower having a leg diameter of 1.25 inches (standard stacked towers). Aluminum construction for corrosion resistance.

Model 191 Crossarm Assembly

The primary mounting device for meteorological sensors. Includes cross fitting to mount to vertical or horizontal 3/4" IPS pipe, such as the #2420 Instrument boom.



Instrument Lift Carriage

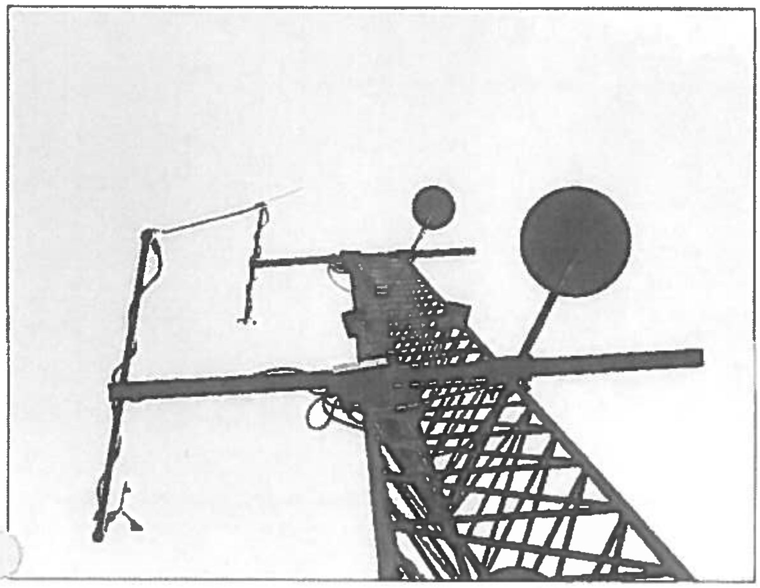
Model 173/175 Instrument Lifts

To avoid the difficulty and danger of tower climbing, the instrument lift is used to return sensors to ground level. Service to the system is easily accomplished without the expense and delay of contracting a professional climber.

Major structural members are hot-dipped galvanized steel. A three-foot instrument boom is standard with all instrument lift systems.

The Model 173 provides a continuous loop drive cable to positively raise and lower an instrument carriage to a maximum height of 100 feet (30 meters). A powered drive winch is an available option.

The Model 175 is a light duty system utilizing a hand-crank winch. The maximum recommended height for this system is 50 feet (15 meters).



Boom and Crossarm Assemblies

Tripod Towers

Tripod towers provide an economical, quick, and easy solution for sensor mounting. We offer a variety of tripods to meet virtually any meteorological system requirement.

Model 2150/2151 Tripods

Lightweight and sturdy, these tripods are constructed of galvanized steel tubing, and come fully assembled. Installation is accomplished by simply opening the legs and installing the mast. Each leg is furnished with a swiveling foot, enabling the tripod to be installed either on a flat surface or a pitched roof. A complete guying kit, including ground stakes, is included. The1-1/4" OD aluminum mast includes a reducer to allow use of an optional Model 191 Crossarm assembly.

Specifications

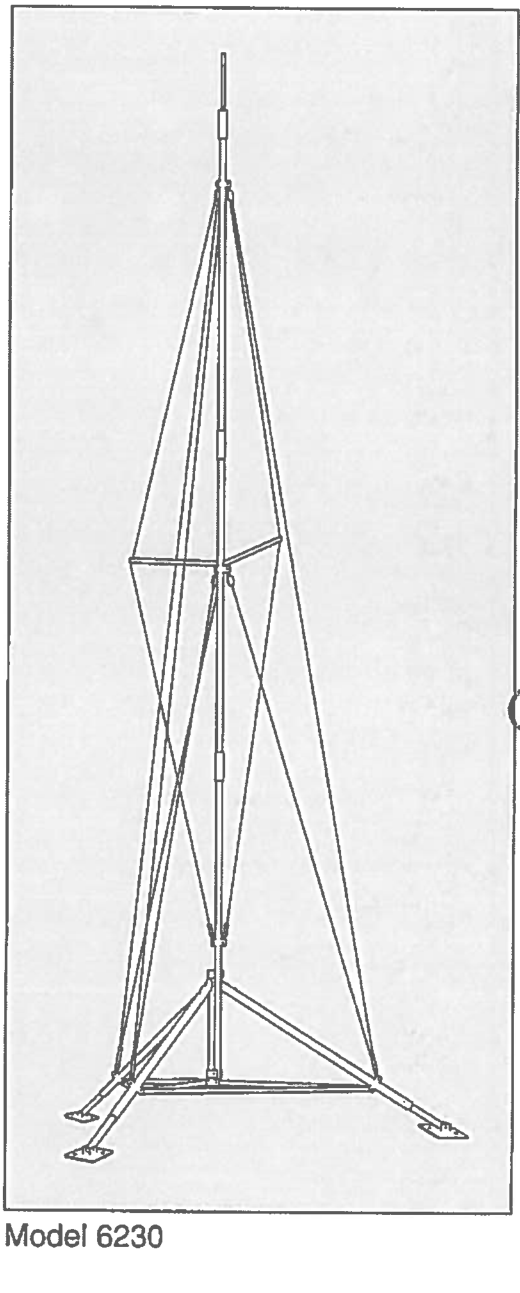
Model	Height to top of mast	Weight (approx.)
2150	11 Ft.	13 lbs.
2151	14 Ft.	18 lbs.

Model 6168/6230 Tripods

"Heavy-duty, self-supporting and extremely robust" describe these tripod towers. The unique design features self-contained guying and a wide footprint to provide strength and stability even in winds as high as 100 mph. Constructed of heavy aluminum tubing, the design features a fold-over mast to ease installation and facilitate servicing of the installed equipment. Heavy galvanized steel "feet and ankles" contribute to stability and are adjustable to conform to terrain variations. The feet can be staked to the ground for added stability. The strength, stability, and economy of these tripods make them a viable alternative to traditional instrument towers.

Specifications

Model	Height to top of mast	Weight (approx.)
6168	20 Ft. (6 M)	170#
6230	33 Ft. (10 M)	205#



Model 6230

Tower Erection and Turnkey Systems

Frequently the customer will find it expeditious and economical for a single contractor to have complete site and system responsibility. Unfortunately it is not easy to find a company that knows both sensors *and* pouring concrete. Met One Instruments has this knowledge—and the experience—gained from supplying numerous turnkey systems throughout the country and overseas. Met One Instruments' project engineers are conversant in all phases of construction associated with meteorological sites. Consult our sales department for budgetary estimates or firm quotations.

MODEL 5284
TOWER GROUNDING SYSTEM

OPERATION MANUAL
DOCUMENT 5284-9800

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

5284 Tower Lightning Rod And Grounding System

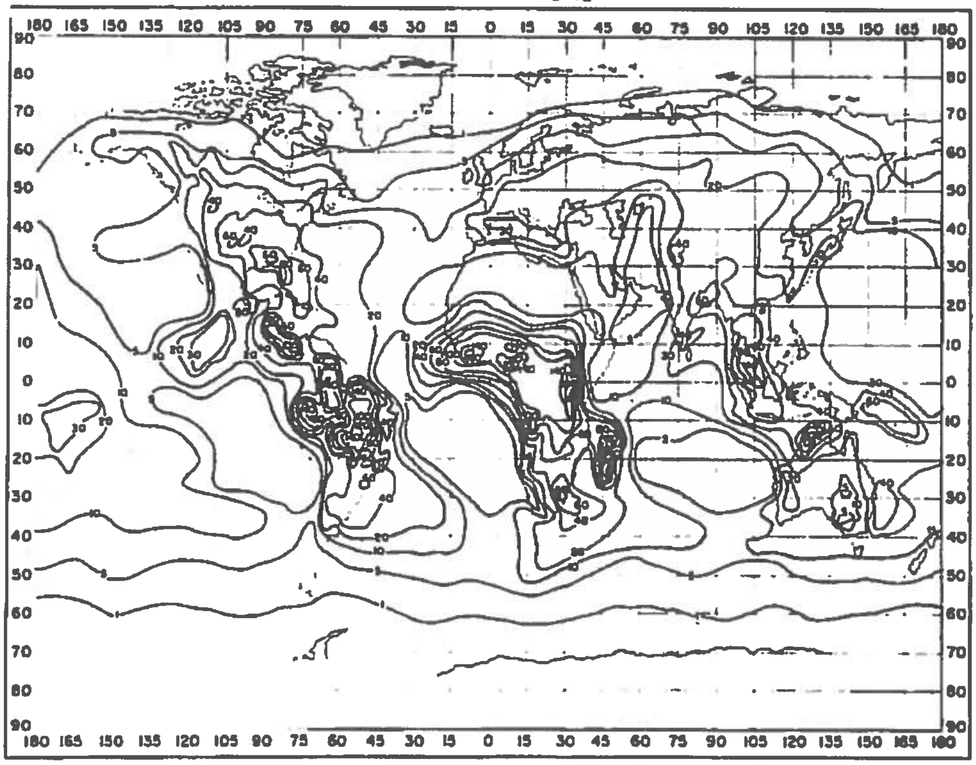
Introduction
High voltage electrical surges caused by lightning are a common source of failure of both sensors and associated electronics. In addition to the protection devices built in to our sensors, Met One provides has provided a tower ground system. The grounding system and lightning rod will increase the likelihood that the system will survive a lightning strike. However a direct strike, no matter how well protected, will likely result in component or system failure.

The part number 5284 Tower Lightning Rod And Grounding System provides an air terminal at the top of the tower, that is connected to earth ground using a heavy gauge copper wire. It provides a direct path to ground from electrical energy caused by a strike or by the EMF of a nearby strike. The system provides a 60 degree cone of protection from the apex of the air terminal to the ground.

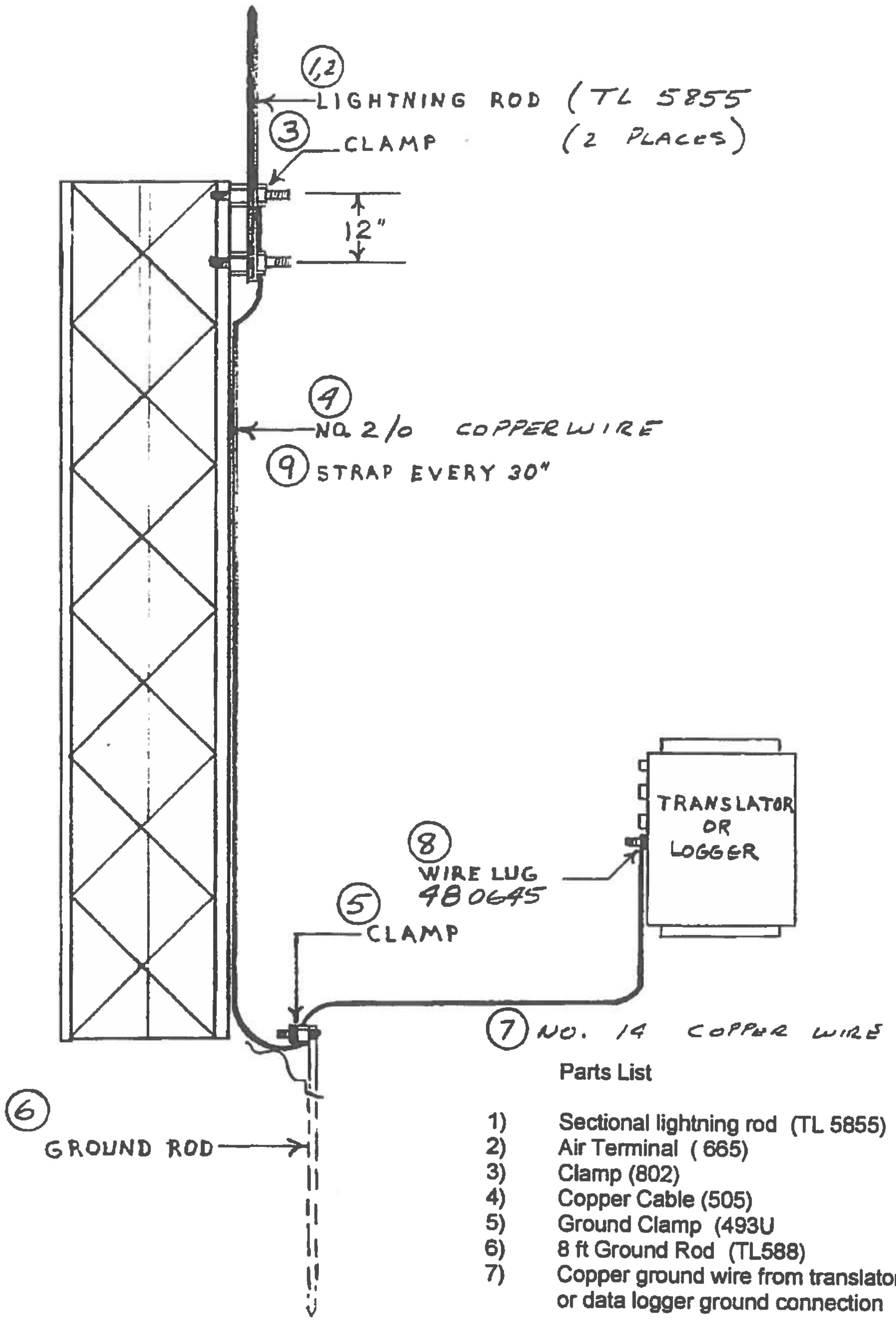
Installation
Installation of the various components is very easy. The basic idea is to have the vertical air terminal at the top of the tower mounted using the two clamps and cable provided. At the base of the tower a ground rod is driven into the ground and the opposite end of the cable is attached to this point. If a base grounding kit was provided with the tower, add the additional ground rod to the base grounding kit to improve the ground resistance. See Figures 1 and 2 for basic details of the installation.

If the tower base grounding kit was supplied with the tower, be sure that the heavy gauge braided copper wire is used for attachment to the ground rod. The small #4 cables should be used for the connection from the tower legs to the other ground rods. For maximum effectiveness of the grounding system, the ground resistance to the rod should be less than 10 ohms.

THUNDERSTORM DAYS



YEAR



Parts List

1) Sectional lightning rod (TL 5855)
2) Air Terminal (665)
3) Clamp (802)
4) Copper Cable (505)
5) Ground Clamp (493U
6) 8 ft Ground Rod (TL588)
7) Copper ground wire from translator or data logger ground connection

FIGURE #1 Tower Lightning Rod and Grounding System

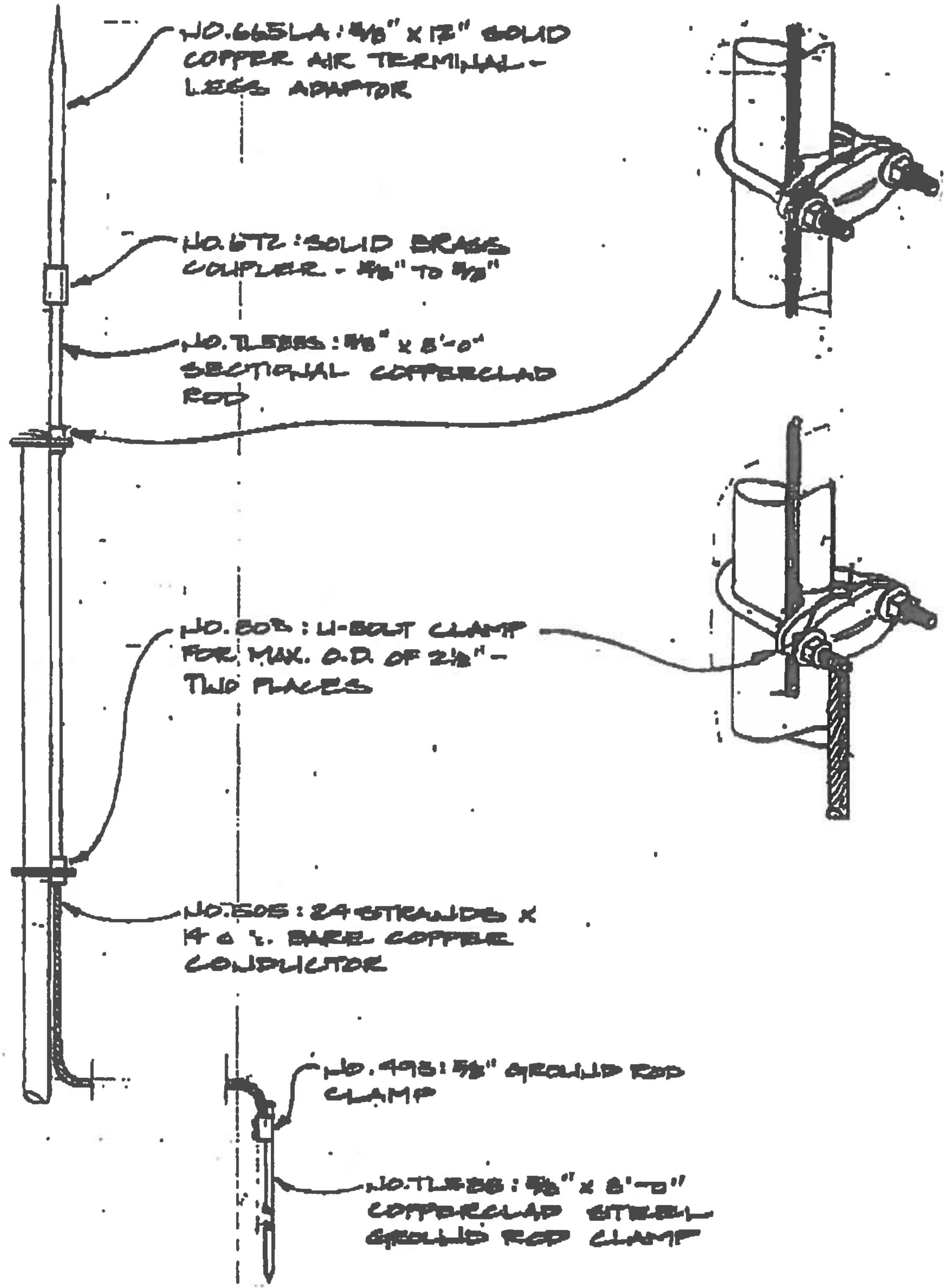


Figure #2 Clamping to lightning rod installation detail

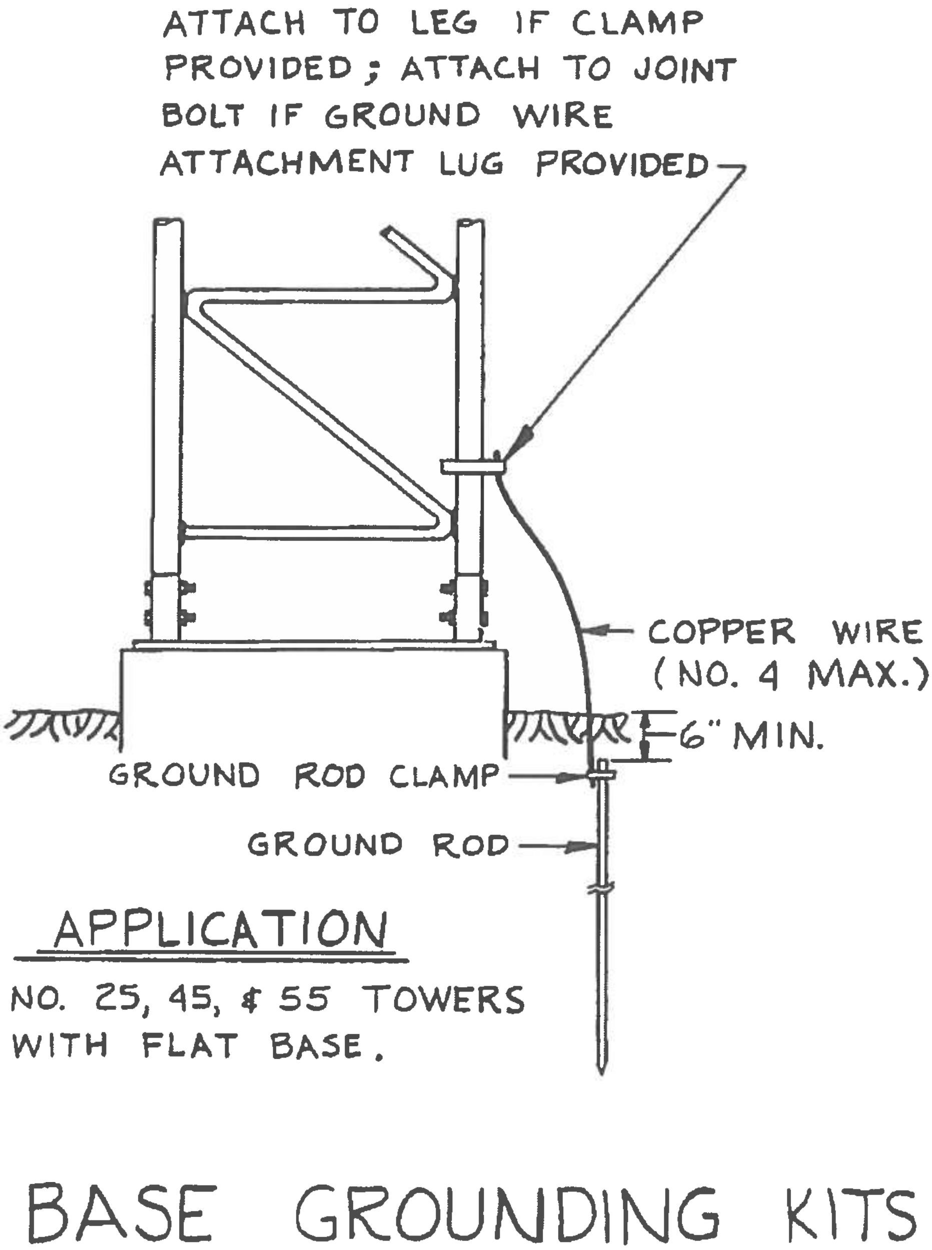


Figure #3 Tower Base Grounding Kit Detail

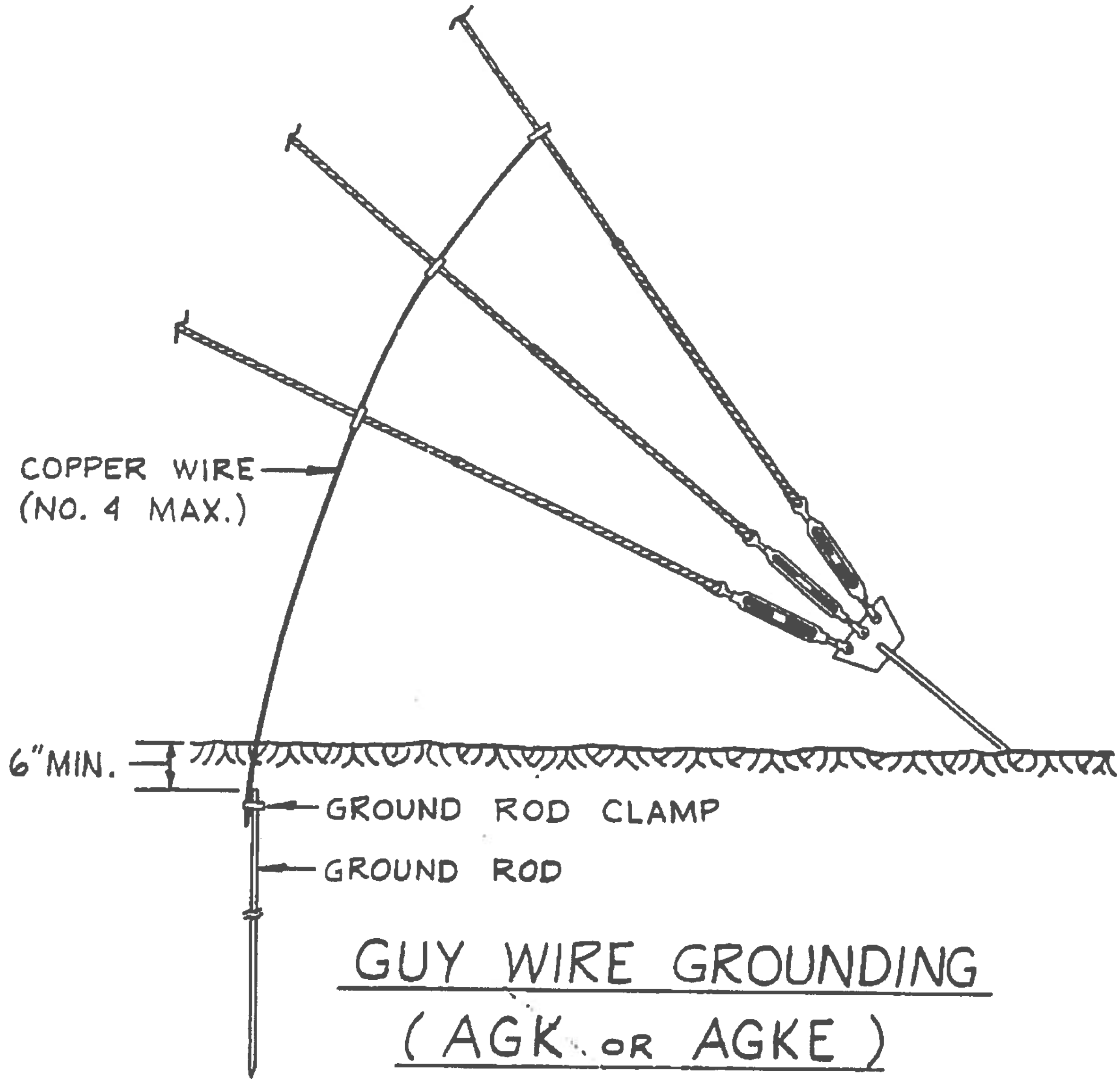
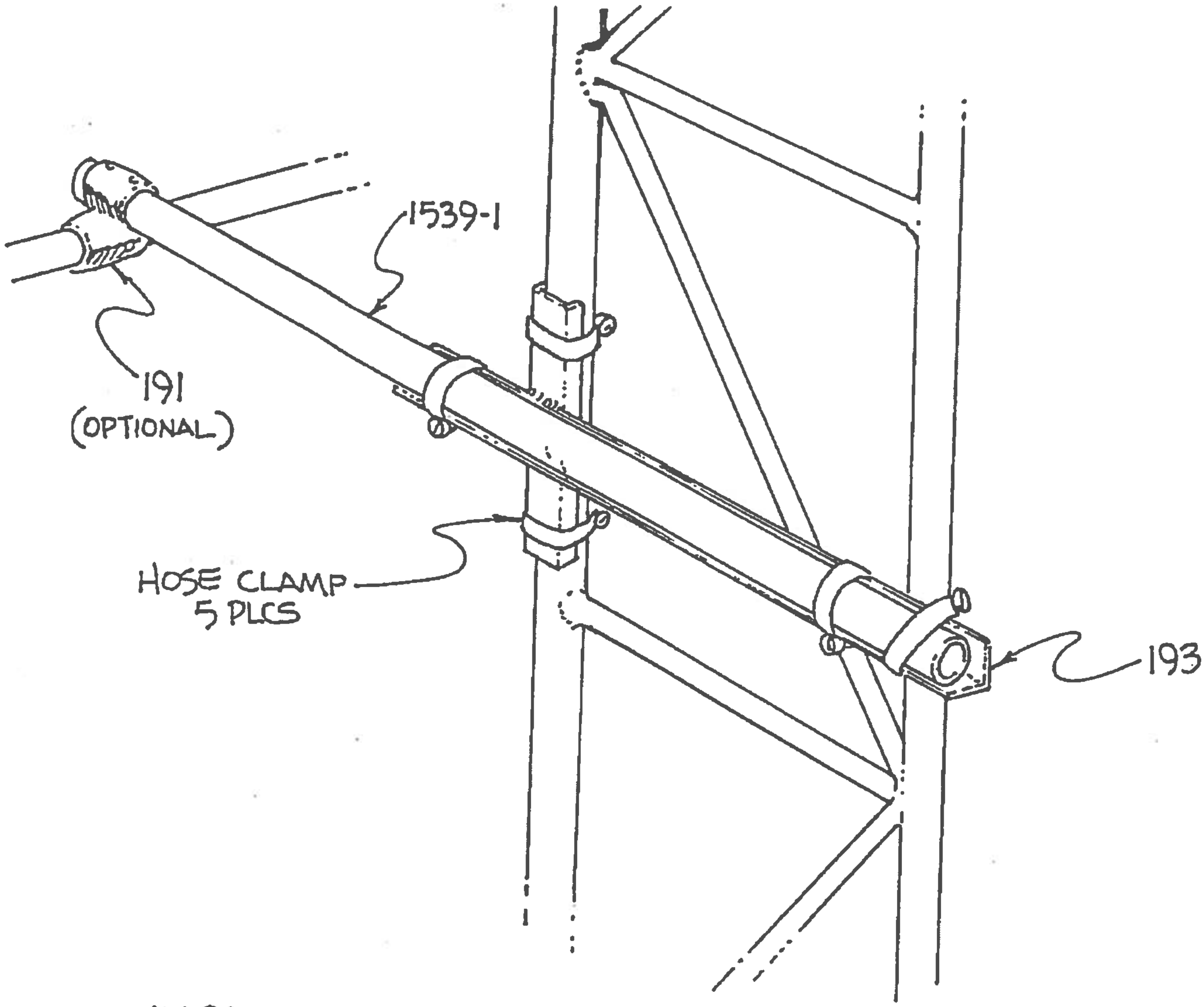
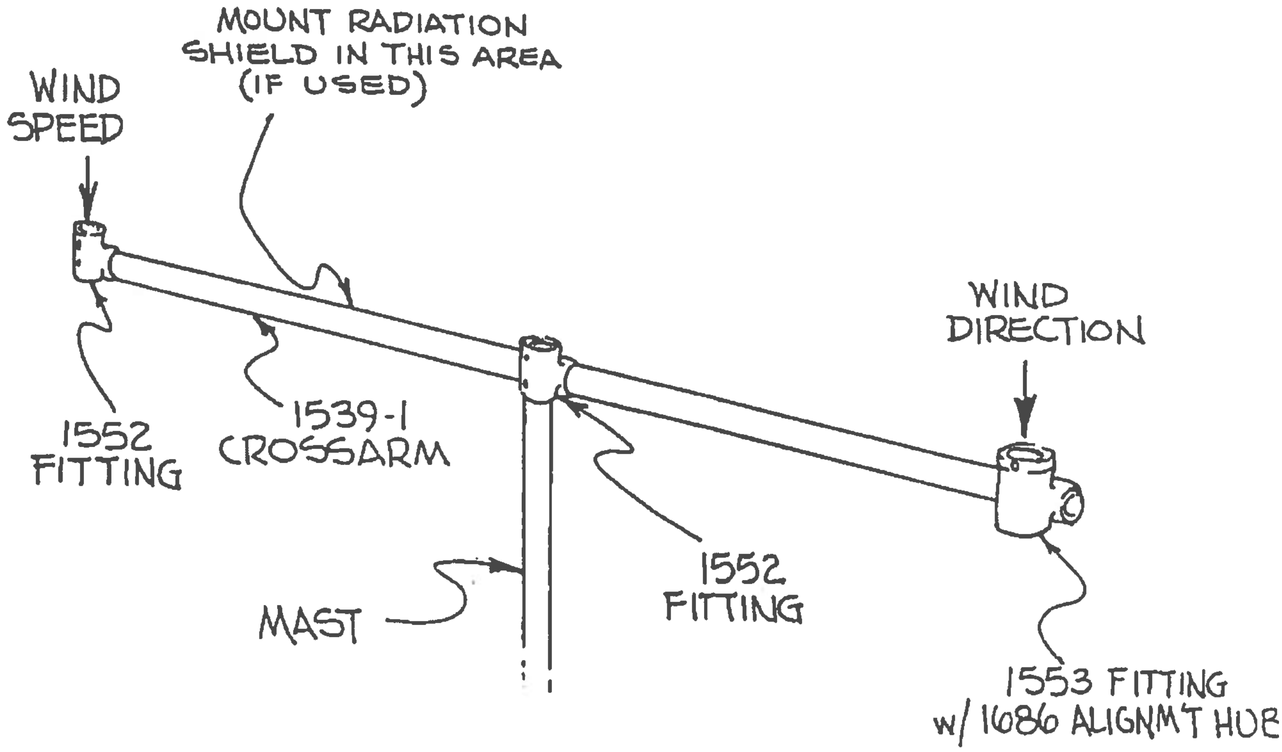


Figure #4 Anchor Grounding Kit Detail



INSTALLATION
193 UNIVERSAL MOUNT
24 JUN '92 RW/MS
DWG # 6408



INSTALLATION
191-1 CROSSARM ASSY

MAR 1 1 1993

MET ONE NORTHWEST

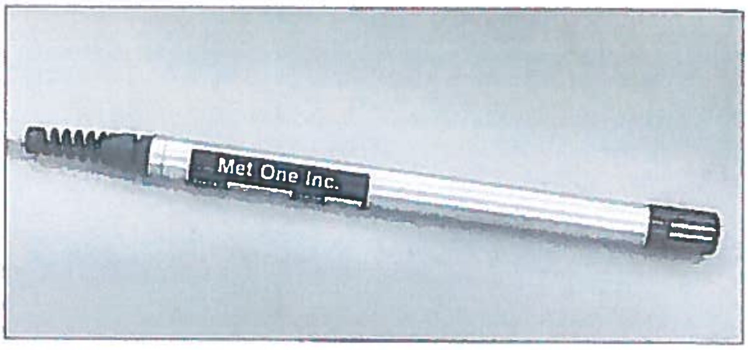
9MAR93 RWms

DRAWING NO. 6400-1

Relative Humidity Sensor

083C

The Model 083C sensor probe represents sensitivity, accuracy, linearity and stability not encountered with conventional relative humidity sensors. It is extremely well suited for meteorological, industrial, laboratory and other demanding applications.



The Model 083C Relative Humidity Sensor is extremely well suited for meteorological, industrial, laboratory and other demanding applications.

Features

- All solid state construction
- Fast response of less than five seconds
- Low power consumption of 4 ma at 12 VDC
- Easily cleaned using distilled water
- 0-1V output for 0-100% RH
- Will operate from a 12 VDC battery

The model 083C RH sensor can also be supplied with a Temperature Sensor mounted in it and used with various radiation shields for reliable, accurate measurements.

Operation

The model 083C Relative Humidity Sensor is based upon the capacitance change of a polymer thin film capacitor. A one-micron thick dielectric polymer layer absorbs water molecules through a thin metal electrode and causes capacitance change proportional to relative humidity. The thin polymer layer reacts very fast, and therefore, the response time is very short—less than five seconds to 90% of the final value of relative humidity. The sensor responds to the full range from 0-100% relative humidity. Its response is essentially linear, with small hysteresis, and negligible temperature dependence.

Construction

The sensor is mounted in a small probe which contains all the electronics necessary to provide an output for indicating or recording humidity. Since the capacitance change of the sensor is sensitive only to the ambient humidity, temperature compensation is not required for most applications. The probe body is water tight and made from corrosion resistant aluminum. Immersion in water does not affect the calibration of the sensor.

The polymer material is resistant to most chemicals. The calibration of the sensor is not affected by liquid.

Specifications

Sensing Element:	Thin film capacitor	
Range:	0-100% Relative Humidity	
Temperature Range:	-20°C to +60°C	
Response Time:	Less than 15 seconds at 68°F of Final (with filter)	
Accuracy:	0-10%	±3%
	10-90%	±2%
	90-100%	±3%
Temperature Coefficient:	0.04% RH/°C	
Output:	0-1.00 VDC - Standard	
Input Power:	4 MA at 12 VDC Battery	
Dimensions:	Diameter 0.75" Length 7.5"	
Weight:	2.5 oz.	

Subject to change without notice.

Met One Instruments, Inc.

Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

Ordering Information

083C – X – Y

X:

– 0	Temperature Sensor not included
– 1	–50 to +50°C, 060 type Temperature Sensor included

Y:

– 1	With connector for direct use with Model 071 Vane Radiation Shield
– 35	With connector for direct use with Model 073B Radiation Shield or Model 075B Solar Powered Radiation Shield
– 6	With 6" Signal Cable for direct use with Model 076B Motor Aspirated Radiation Shield

MODEL 083C
RELATIVE HUMIDITY/TEMPERATURE SENSOR

OPERATION MANUAL

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

083C RELATIVE HUMIDITY/TEMPERATURE SENSOR
OPERATION MANUAL

1.0 GENERAL INFORMATION

1.1 The 083C Sensor contains an extremely accurate and sensitive relative humidity sensor which responds to the full range of 0-100% humidity. Response is linear with small hysteresis and negligible temperature dependence. The sensor is designed to be housed in a radiation shield when used outdoors. Certain models also contain a high-accuracy linearized air temperature sensor, permitting simultaneous measurement of relative humidity and temperature.

1.2 The 083C Sensor model number describes the sensor options as follows:

083C - X - Y

X is the temperature option:

0 = no temperature sensor
1 = -50 to +50°C temperature sensor

Other temperature options are available.

Y is the radiation shield compatibility option:

-Y	Radiation Shield	Signal Cable
- 1	071	1873 -ZZ (ZZ = cable length in feet)
- 6	076	2144 -ZZ
- 6	077	2408 -ZZ
-35	073B	2348 -ZZ
-35	075B	2348 -ZZ

1.3 The Sensor Cable is vinyl-jacketed and shielded. Cable length is given in feet on each cable part number. The cable part number depends on which radiation shield the sensor is mounted in. The 077 Radiation Shield has a screw type terminal strip to accept wire leads from the 2408 cable. All other Radiation Shields and cables have Mil Spec screw-on or twist-on cable connectors.

The 083C-X-6 sensor mounts in either a 076B Radiation Shield, with a 2144-ZZ signal cable or a 077 Radiation Shield with a 2408-ZZ signal cable.

Table 1.1
Model 083C Relative Humidity Sensor Specifications

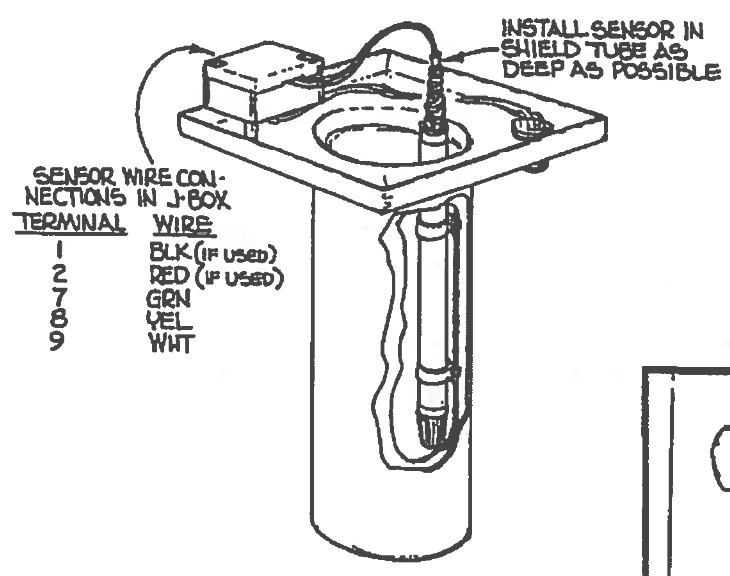
Sensing Element	Thin-film capacitor
Range	0-100% RH
Temperature Range	-20°F to +50°C
Response Time	15 seconds at 68°F 90% of final RH value
Accuracy	Better than ±3% between 10% and 90%
Hysteresis	For 0% to 100% to 0% excursion less than ±1%
Temperature Coefficient	±0.04% per 1°C
Output	0 - 1V at full scale (standard)
Input Power	12V DC ± 2V, 12 ma

Table 1.2
Model 083C-1 RH/Temp Sensor Specifications

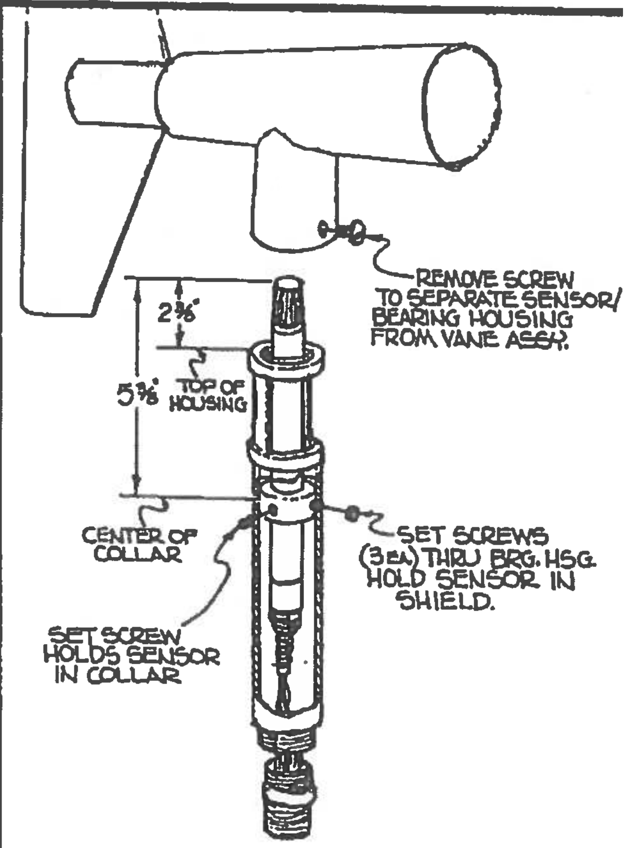
Range	-50° to +50°C (standard range)
Linearity	±0.15°C
Accuracy	±0.10°C
Time Constant	10 sec.

2.0 INSTALLATION

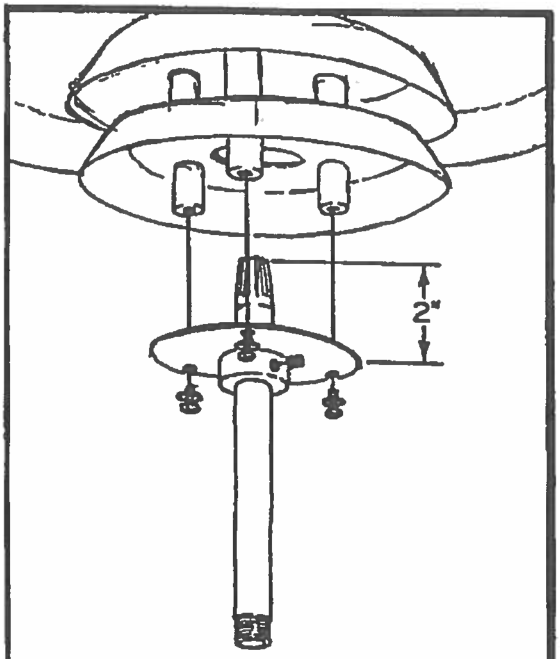
2.1 If sensor comes mounted in a radiation shield, refer to radiation shield manual section for mounting details. Sensors not furnished in a radiation shield should be mounted in a representative location having good air flow and shaded from sunlight or other heat radiation sources that would affect measurement of relative humidity or temperature.



MODEL 076B



MODEL 071



MODEL 073B

TYPICAL 083C SENSOR INSTALLATIONS IN STANDARD RADIATION SHIELDS

3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 Relative Humidity Measurement

3.2 Relative Humidity Sensor Check-out

1. To verify correct wiring and as a rough test of sensor operation, blow on the sensor. The relative humidity will rise to a higher level.

2. The Relative Humidity Sensor has been calibrated at the factory and will not change unless it is damaged. To check for proper operation of the sensor it is advised that the output signal be checked against a local weather service facility. Exact correlation is not to be expected due to atmospheric and geographical variations.

3.3 Temperature Sensor

1. Compare actual readings with precision mercury thermometer. As an alternative, measure sensor resistance with a Lo Current Digital Ohm Meter and compare readings of temperature vs resistance. See Table 3.1.

4.0 MAINTENANCE AND TROUBLE SHOOTING

4.1 General Maintenance Schedule*

6 - 12 Month Intervals:

A. Inspect sensors for proper operation per Section 3.0.

B. Clean Relative Humidity sensor element per Section 4.2A.

*Schedule is based on average to adverse environments.

4.2 083 Relative Humidity Sensor Maintenance and Calibration

Warning: The sensor can be miscalibrated or permanently damaged through improper acts. Do not attempt a repair or calibration if you are unsure of the procedure. Do not touch if you do not know how.

This instrument should operate for an extended period of time with a minimum of care or maintenance.

If parts or maintenance assistance are required, contact Met One Instruments. Obtain shipping instructions before returning any unit.

A. Maintenance

Cleaning the Sensor Element. Unscrew the filter. Dust and other particles may be removed by gently blowing on the sensor chip. DO NOT USE COMPRESSED AIR. After dusting, the sensor element may be wiped clean with a soft brush dipped in distilled water. DO NOT USE DETERGENTS. DO NOT APPLY POWER TO THE SENSOR WHEN CLEANING, and do not reconnect power to the sensor until the element has dried.

CAUTION: NEVER TOUCH THE SENSOR CHIP WITH BARE HANDS

1. The life of the sensor is related to the environment in which it operates. In a pure air and water vapor surrounding, the sensor element will have an indefinite life. The presence of chemical pollutants in the environment may corrode the materials of the sensor chip. The polymer material is resistant to most chemical attacks, but the metal electrodes, are sensitive to corrosion effects, particularly when a DC voltage is applied to the sensor. The most harmful pollutant has been sulphur dioxide absorption in small soot particles. When such particles fall on the thin metal electrode, they may, if water condensation is present, form traces of sulphuric acid to corrode the surface of the sensor. For these reasons, a careful cleaning as described in the preceding paragraph is recommended whenever the sensor has been exposed to corrosive pollutants. Also, a periodic cleaning every two weeks with an atomizer of distilled water, thoroughly washing the chip clean, may remove harmful particles before they can damage the sensor. Be sure that no power is applied when washing the chip and that power remains off until after the chip has dried.

2. Replacement of Sensor Element. If the sensor element has been damaged, it can be easily replaced. Disconnect power to the probe. Unscrew the filter. Un-solder the old chip and solder a new one in its place. The sensor chip is very delicate, so observe the following precautions. DO NOT TOUCH THE CHIP WITH BARE HANDS. Handle the chip only by gripping its lead with pliers. When soldering, hold the lead with the pliers to prevent the heat from the soldering operation from damaging the chip. Do not bump the chip when reinstating the protective grid.

3. After replacement of the sensor element, the humidity probe must be recalibrated.

B. Humidity Probe Calibration.

1. Before attempting to recalibrate the probe, make sure that the translator module containing the signal conditioning electronics is still properly calibrated. If 0% and 100% do not produce corresponding readings on the indicator, recalibrate the translator module.
2. The calibration method described in this instruction manual is based on the constant water vapor pressure over saturated salt solutions and constant temperature. Materials used for the calibration are Lithium Chloride (LiCl) and Sodium Chloride (NaCl). The former creates a humidity of approximately 13% and the latter approximately 76% in 68°F (20°C) ambient temperature. Both of these chemical agents are available from chemical suppliers. To guarantee accurate calibration, the salts must be of high purity.

TEST EQUIPMENT REQUIRED:

2 Calibration Bottles: HM-111-CG-L and HM-111-CB-N
Lithium Chloride Salts, Reagent Grade 1
Sodium Chloride, Reagent Grade 1
Thermometer to measure ambient temperature
Distilled water

3. Preparations for Calibration

Refer to instructions with the calibration bottles for mixing the solutions.

The calibration bottles can be used for up to one year without changing fresh chemicals. The bottles should be stored in a place with constant temperature, so as to have them ready for use with just a short preparation time. Do not shake the bottle with salt solution before use. Care should be taken to see that there are no droplets of salt solution inside the mouth piece of the bottle. This might affect the accuracy of the calibration. Do not get any salt solution on the sensor element directly.

TABLE 4-1
Calibration Tables

<u>LITHIUM CHLORIDE</u>

Ambient Temperature °C	10	15	20	25	30	35	40
Calibration Value % RH	14.3	13.8	13.4	13.0	12.8	12.7	12.6

<u>SODIUM CHLORIDE</u>

Ambient Temperature °C	10	15	20	25	30	35	40
Calibration Value % RH	75.2	75.3	75.5	75.8	75.6	75.5	75.4

C. CALIBRATION FOR LOW HUMIDITY (13% RH)

1. Unscrew the filter. Do not bump the sensor element while removing the grid.

2. Pull the rubber plug out of the lithium chloride (LiCl) bottle, and push the sensor probe in its place in the cork's sleeve. The sleeve is fitted with a safety flange and prohibits the probe from falling through.

3. Read the ambient room temperature.

4. Note the humidity percentage from the lithium chloride calibration table, which corresponds to the temperature in question.

5. After 1 hour, read the humidity value, If the reading differs from the table value, adjust R15, zero adjust.

6. After use, close the bottle tightly with the rubber plug.

D. CALIBRATION FOR HIGH HUMIDITY (76%)

Repeat the calibration procedure as described above, but now using the sodium chloride. Adjust R18 (span adjustment) if necessary.

E. Repeat steps C and D until no further adjustments are required.

MODEL 510070
RELATIVE HUMIDITY CALIBRATOR

1.0 GENERAL INFORMATION

1.1 Suitable for all probes. Calibration by means of lithium chloride and sodium chloride saturated salt solutions. Bottles for salt solutions in metal box providing stable temperature. Due to the minimal space of air above the salt solution no ventilation is needed. Solid construction. Humidity and Temperature scale for each salt solution printed on the box lid. A thermometer situated between the salt bottles in the box provides a very reliable calibration.

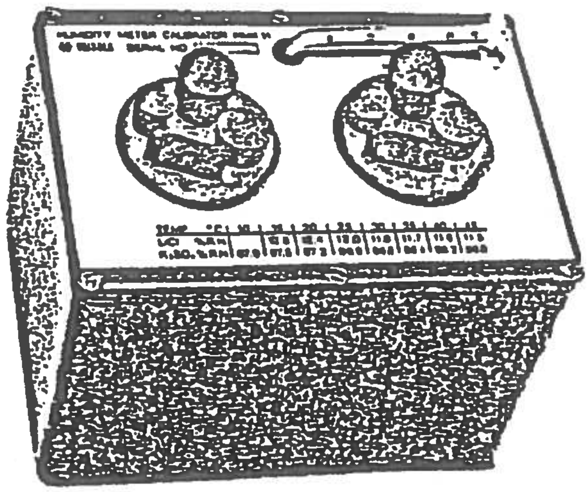
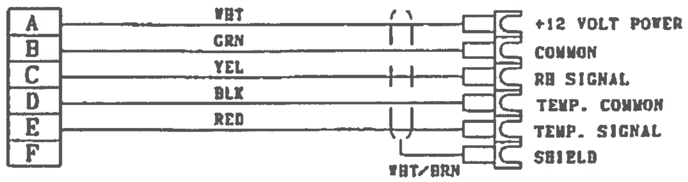
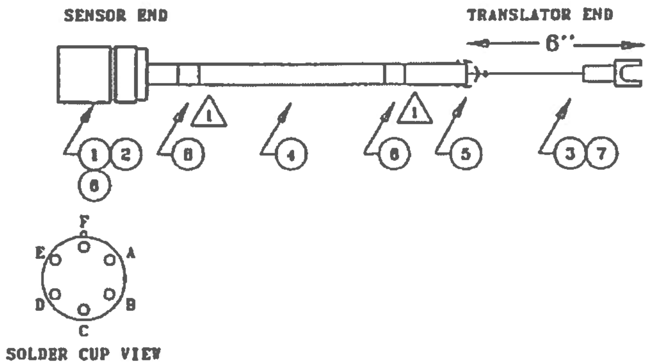


Figure 5
Calibrator before setting up

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REDRAWN PER E.O. 1131	9/11/91	DH





ITEM	PART NO.	DESCRIPTION	QTY
1	500391	CONNECTOR, 6 PIN, FEMALE	1
2	480508	CLAMP	1
3	800193	LUG, SPADE, #6	6
4	400014	CABLE, 5 COND., SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960080	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

⚠1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

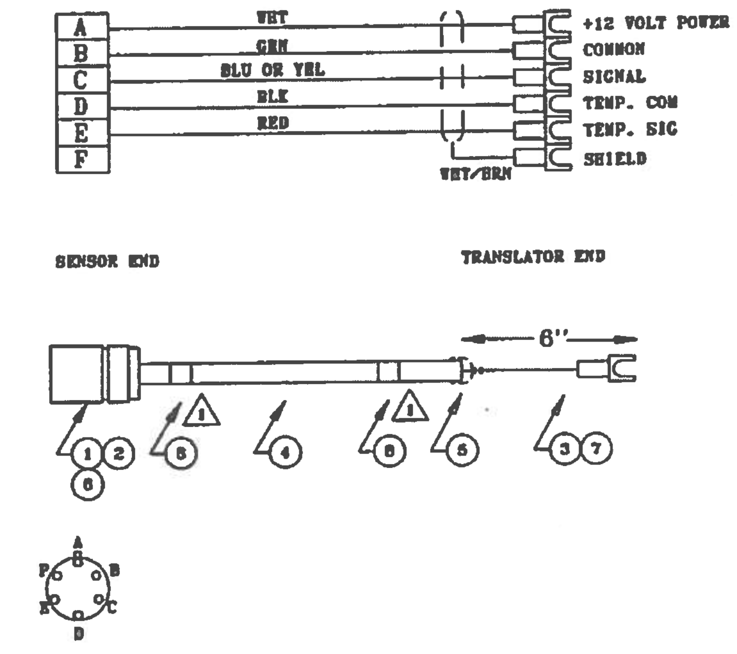
MET ONE INSTRUMENTS

ASSY, CABLE, 083 RH AND TEMPERATURE

SIZE | FSCM NO. | DWG NO. 1873 | REV C

SCALE | SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	PROD REL	5/21/92	DH
B	EO 1191	6/5/92	DH

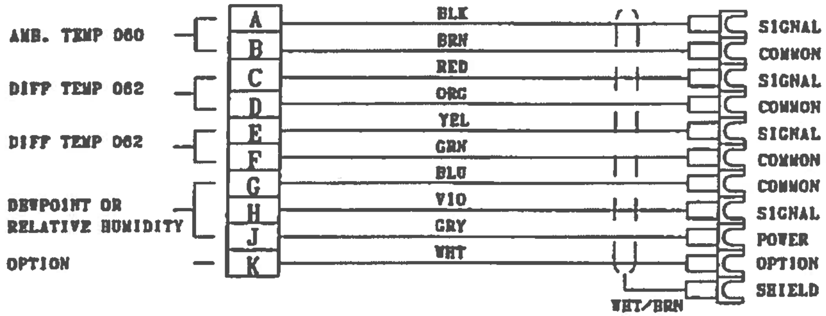


ITEM	PART NO.	DESCRIPTION	QTY
1	500351	CONNECTOR, 6 PIN, FEMALE	1
2	480500	CLAMP	1
3	580193	LUG, SPADE, #6	6
4	400014	CABLE, 5 COND., SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

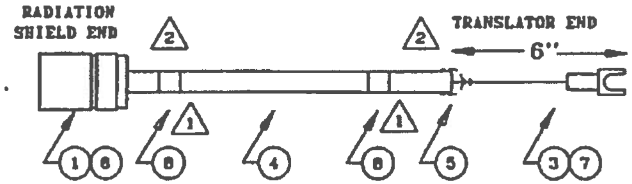
1 IDENTIFY CABLE 18" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

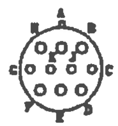
MET ONE INSTRUMENTS	
ASSY, CABLE, RELATIVE HUMIDITY AND TEMPERATURE	
SIZE / FSCM NO. / DWG NO. 2348	REV A
SCALE	SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REDRAWN AND ADD PARTS LIST	9/13/91	DH



ITEM	PART NO.	DESCRIPTION	QTY
1	500296	CONNECTOR, 10 PIN	1
2			
3	600193	LUG, SPADE, #8	6
4	400017	CABLE, 12 WIRE, SHIELDED	A/R
5	960096	SLEEVING, 3/8, SHRINK	A/R
6	960093	SLEEVING, 3/32, SHRINK	A/R
7	980510	WIRE, 22 AWG, WHT/BRN	6"
8	960065	SLEEVING, 1/2", CLEAR	A/R
9			
10			





SOLDER CUP VIEW

1. IDENTIFY CABLE 18" FROM EACH END. DASH NUMBER = LENGTH IN FEET.

2. CUT OFF WHT/BRN AND WHT/BLK WIRES AT BOTH ENDS. SOLDER WHT/BRN WIRE TO SHIELD ON TRANSLATOR END. USE ITEM 6 TO COVER SOLDER JOINT ON SHEILD.

	MET ONE INSTRUMENTS
	ASSY, CABLE, SIGNAL OUT, 076B /JUNCTION BOX
	SIZE	FSCM NO.	DWG NO. 2144	REV D
	SCALE	SHEET 1 OF 1

MODEL 077 RADIATION SHIELD
WIRING TABLE
CABLE NO. 2408

COLOR	USE
RED	AT SIG
BLACK	AT COM
GREEN	RH COM
WHITE	RH +12V
YELLOW	RH SIG
WHT/BRN	SHIELD

MODEL 077 RADIATION SHIELD
WIRING TABLE
CABLE NO. 2409

COLOR	USE
RED	POWER
BLACK	COM

RESISTANCE TABLE 3.1

MODELS 060A-4,063-2

TEMP DEG C	RNOM*	RCAL	TEMP DEG C	RNOM*	RCAL
0	2768.230	20516.330	50	1912.480	4753.275
1	2751.115	19612.079	51	1895.365	4648.939
2	2734.000	18774.249	52	1878.250	4547.305
3	2716.885	17995.782	53	1861.135	4448.269
4	2699.770	17270.584	54	1844.020	4351.734
5	2682.655	16593.368	55	1826.905	4257.605
6	2665.540	15959.526	56	1809.790	4165.794
7	2648.425	15365.018	57	1792.675	4076.216
8	2631.310	14806.295	58	1775.560	3988.790
9	2614.195	14280.220	59	1758.445	3903.440
10	2597.080	13784.011	60	1741.330	3820.094
11	2579.965	13315.197	61	1724.215	3738.680
12	2562.850	12871.569	62	1707.100	3659.133
13	2545.735	12451.151	63	1689.985	3581.390
14	2528.620	12052.167	64	1672.870	3505.389
15	2511.505	11673.020	65	1655.755	3431.072
16	2494.390	11312.266	66	1638.640	3358.385
17	2477.275	10968.598	67	1621.525	3287.274
18	2460.160	10640.830	68	1604.410	3217.689
19	2443.045	10327.885	69	1587.295	3149.580
20	2425.930	10028.778	70	1570.180	3082.902
21	2408.815	9742.611	71	1553.065	3017.610
22	2391.700	9468.564	72	1535.950	2953.661
23	2374.585	9205.881	73	1518.835	2891.014
24	2357.470	8953.870	74	1501.720	2829.630
25	2340.355	8711.894	75	1484.605	2769.471
26	2323.240	8479.365	76	1467.490	2710.500
27	2306.125	8255.740	77	1450.375	2652.683
28	2289.010	8040.519	78	1433.260	2595.986
29	2271.895	7833.234	79	1416.145	2540.377
30	2254.780	7633.457	80	1399.030	2485.825
31	2237.665	7440.785	81	1381.915	2432.300
32	2220.550	7254.847	82	1364.800	2379.773
33	2203.435	7075.296	83	1347.685	2328.217
34	2186.320	6901.807	84	1330.570	2277.605
35	2169.205	6734.080	85	1313.455	2227.912
36	2152.090	6571.832	86	1296.340	2179.112
37	2134.975	6414.798	87	1279.225	2131.181
38	2117.860	6262.731	88	1262.110	2084.098
39	2100.745	6115.400	89	1244.995	2037.838
40	2083.630	5972.586	90	1227.880	1992.382
41	2066.515	5834.085	91	1210.765	1947.708
42	2049.400	5699.705	92	1193.650	1903.795
43	2032.285	5569.263	93	1176.535	1860.626
44	2015.170	5442.590	94	1159.420	1818.181
45	1998.055	5319.525	95	1142.305	1776.442
46	1980.940	5199.915	96	1125.190	1735.392
47	1963.825	5083.617	97	1108.075	1695.013
48	1946.710	4970.495	98	1090.960	1655.290
49	1929.595	4860.422	99	1073.845	1616.206
50	1912.480	4753.275	100	1056.730	1577.746

*VALUE WITH A 3200 OHM RESISTOR IN PARALLEL WITH THE SENSOR

RANGE 0 TO 100 DEGREE C
THERMISTOR BEAD 44201
RNOM = (-17.115)T+2768.23 WHERE T = TEMPERATURE IN DEGREE CENTIGRADE

RESISTANCE TABLE 3.1

MODELS 060A-4,063-2

TEMP DEG F	RNOM*	RCAL	TEMP DEG F	RNOM*	RCAL
32	2768.224	20516.001	84	2273.808	7856.023
33	2758.716	20005.011	85	2264.300	7743.679
34	2749.208	19515.576	86	2254.792	7633.594
35	2739.700	19046.361	87	2245.284	7525.703
36	2730.192	18596.138	88	2235.776	7419.939
37	2720.684	18163.777	89	2226.268	7316.241
38	2711.176	17748.235	90	2216.760	7214.548
39	2701.668	17348.550	91	2207.252	7114.803
40	2692.160	16963.831	92	2197.744	7016.951
41	2682.652	16593.253	93	2188.236	6920.937
42	2673.144	16236.051	94	2178.728	6826.712
43	2663.636	15891.512	95	2169.220	6734.225
44	2654.128	15558.976	96	2159.712	6643.428
45	2644.620	15237.826	97	2150.204	6554.276
46	2635.112	14927.487	98	2140.696	6466.725
47	2625.604	14627.422	99	2131.188	6380.731
48	2616.096	14337.129	100	2121.680	6296.253
49	2606.588	14056.139	101	2112.172	6213.253
50	2597.080	13784.011	102	2102.664	6131.691
51	2587.572	13520.333	103	2093.156	6051.530
52	2578.064	13264.717	104	2083.648	5972.734
53	2568.556	13016.798	105	2074.140	5895.269
54	2559.048	12776.235	106	2064.632	5819.102
55	2549.540	12542.705	107	2055.124	5744.200
56	2540.032	12315.904	108	2045.616	5670.532
57	2530.524	12095.545	109	2036.108	5598.067
58	2521.016	11881.357	110	2026.600	5526.777
59	2511.508	11673.085	111	2017.092	5456.633
60	2502.000	11470.487	112	2007.584	5387.607
61	2492.492	11273.335	113	1998.076	5319.673
62	2482.984	11081.411	114	1988.568	5252.806
63	2473.476	10894.510	115	1979.060	5186.981
64	2463.968	10712.439	116	1969.552	5122.172
65	2454.460	10535.011	117	1960.044	5058.358
66	2444.952	10362.052	118	1950.536	4995.514
67	2435.444	10193.394	119	1941.028	4933.620
68	2425.936	10028.880	120	1931.520	4872.654
69	2416.428	9868.359	121	1922.012	4812.595
70	2406.920	9711.686	122	1912.504	4753.423
71	2397.412	9558.726	123	1902.996	4695.118
72	2387.904	9409.347	124	1893.488	4637.662
73	2378.396	9263.425	125	1883.980	4581.037
74	2368.888	9120.842	126	1874.472	4525.223
75	2359.380	8981.485	127	1864.964	4470.205
76	2349.872	8845.245	128	1855.456	4415.965
77	2340.364	8712.019	129	1845.948	4362.487
78	2330.856	8581.707	130	1836.440	4309.754
79	2321.348	8454.216	131	1826.932	4257.752
80	2311.840	8329.454	132	1817.424	4206.464
81	2302.332	8207.335	133	1807.916	4155.878
82	2292.824	8087.777	134	1798.408	4105.978
83	2283.316	7970.698	135	1788.900	4056.750

*VALUE WITH A 3200 OHM RESISTOR IN PARALLEL WITH THE SENSOR

RANGE 32 TO 212 DEGREE FARENHEIT
THERMISTOR BEAD 44201
RNOM = (-9.508)T+3072.48 WHERE T = TEMPERATURE IN DEGREE FARENHEIT

RESISTANCE TABLE 3.1

MODELS 060A-4,063-2

TEMP DEG F	RNOM*	RCAL
136	1779.392	4008.181
137	1769.884	3960.258
138	1760.376	3912.968
139	1750.868	3866.299
140	1741.360	3820.238
141	1731.852	3774.774
142	1722.344	3729.894
143	1712.836	3685.589
144	1703.328	3641.846
145	1693.820	3598.656
146	1684.312	3556.008
147	1674.804	3513.891
148	1665.296	3472.296
149	1655.788	3431.214
150	1646.280	3390.634
151	1636.772	3350.548
152	1627.264	3310.947
153	1617.756	3271.821
154	1608.248	3233.163
155	1598.740	3194.964
156	1589.232	3157.216
157	1579.724	3119.911
158	1570.216	3083.041
159	1560.708	3046.599
160	1551.200	3010.577
161	1541.692	2974.969
162	1532.184	2939.766
163	1522.676	2904.962
164	1513.168	2870.551
165	1503.660	2836.526
166	1494.152	2802.880
167	1484.644	2769.606
168	1475.136	2736.700
169	1465.628	2704.154
170	1456.120	2671.964
171	1446.612	2640.122
172	1437.104	2608.624
173	1427.596	2577.464
174	1418.088	2546.636
175	1408.580	2516.136
176	1399.072	2485.957
177	1389.564	2456.096
178	1380.056	2426.547
179	1370.548	2397.305
180	1361.040	2368.365
181	1351.532	2339.723
182	1342.024	2311.374
183	1332.516	2283.313
184	1323.008	2255.537
185	1313.500	2228.041
186	1303.992	2200.821
187	1294.484	2173.872
188	1284.976	2147.191
189	1275.468	2120.774
190	1265.960	2094.616
191	1256.452	2068.715
192	1246.944	2043.065
193	1237.436	2017.664
194	1227.928	1992.508
195	1218.420	1967.594
196	1208.912	1942.917
197	1199.404	1918.475
198	1189.896	1894.264
199	1180.388	1870.281
200	1170.880	1846.523
201	1161.372	1822.986
202	1151.864	1799.668
203	1142.356	1776.565
204	1132.848	1753.675
205	1123.340	1730.995
206	1113.832	1708.521
207	1104.324	1686.252
208	1094.816	1664.183
209	1085.308	1642.313
210	1075.800	1620.638
211	1066.292	1599.157
212	1056.784	1577.867

*VALUE WITH A 3200 OHM RESISTOR IN PARALLEL WITH THE SENSOR

RANGE 32 TO 212 DEGREE FARENHEIT
THERMISTOR BEAD 44201
RNOM = (-9.508)T+3072.48 WHERE T = TEMPERATURE IN DEGREE FARENHEIT

TABLE 3.1b

MODELS 060A-2, 063-1, 064-2

TEMP DEG C	RNOM*	RCAL
-50	20156.450	158181.106
-49	20027.287	150560.866
-48	19898.124	143555.423
-47	19768.961	137093.261
-46	19639.798	131113.540
-45	19510.635	125564.179
-44	19381.472	120400.331
-43	19252.309	115583.174
-42	19123.146	111078.926
-41	18993.983	106858.059
-40	18864.820	102894.645
-39	18735.657	99165.826
-38	18606.494	95651.371
-37	18477.331	92333.314
-36	18348.168	89195.637
-35	18219.005	86224.021
-34	18089.842	83405.623
-33	17960.679	80728.891
-32	17831.516	78183.405
-31	17702.353	75759.744
-30	17573.190	73449.366
-29	17444.027	71244.510
-28	17314.864	69138.108
-27	17185.701	67123.710
-26	17056.538	65195.417
-25	16927.375	63347.824
-24	16798.212	61575.968
-23	16669.049	59875.286
-22	16539.886	58241.574
-21	16410.723	56670.953
-20	16281.560	55159.837
-19	16152.397	53704.907
-18	16023.234	52303.087
-17	15894.071	50951.521
-16	15764.908	49647.554
-15	15635.745	48388.715
-14	15506.582	47172.702
-13	15377.419	45997.365
-12	15248.256	44860.698
-11	15119.093	43760.822
-10	14989.930	42695.980
-9	14860.767	41664.524
-8	14731.604	40664.908
-7	14602.441	39695.681
-6	14473.278	38755.477
-5	14344.115	37843.011
-4	14214.952	36957.076
-3	14085.789	36096.529
-2	13956.626	35260.295
-1	13827.463	34447.357
0	13698.300	33656.757

TEMP DEG C	RNOM*	RCAL
1	13569.137	32887.585
2	13439.974	32138.982
3	13310.811	31410.134
4	13181.648	30700.268
5	13052.485	30008.654
6	12923.322	29334.596
7	12794.159	28677.434
8	12664.996	28036.540
9	12535.833	27411.318
10	12406.670	26801.200
11	12277.507	26205.645
12	12148.344	25624.138
13	12019.181	25056.188
14	11890.018	24501.325
15	11760.855	23959.104
16	11631.692	23429.096
17	11502.529	22910.893
18	11373.366	22404.106
19	11244.203	21908.362
20	11115.040	21423.303
21	10985.877	20948.587
22	10856.714	20483.888
23	10727.551	20028.891
24	10598.388	19583.296
25	10469.225	19146.814
26	10340.062	18719.169
27	10210.899	18300.095
28	10081.736	17889.336
29	9952.573	17486.649
30	9823.410	17091.796
31	9694.247	16704.553
32	9565.084	16324.700
33	9435.921	15952.028
34	9306.758	15586.336
35	9177.595	15227.430
36	9048.432	14875.121
37	8919.269	14529.231
38	8790.106	14189.584
39	8660.943	13856.015
40	8531.780	13528.360
41	8402.617	13206.464
42	8273.454	12890.176
43	8144.291	12579.352
44	8015.128	12273.850
45	7885.965	11973.536
46	7756.802	11678.278
47	7627.639	11387.949
48	7498.476	11102.428
49	7369.313	10821.595
50	7240.150	10545.337

* VALUE WITH 23.1K RESISTOR IN PARALLEL WITH SENSOR

RANGE -50 TO +50C OR -58 TO +122F
THERMISTOR BEAD 44212
RNOM=(-129.163)T + 13698.3 WHERE T = TEMPERATURE IN DEGREE CENTEGRADE

For RCAL:

$$Tc = ((((R+^{-1}) + (23100^{-1}))^{-1} - 13698.3)/-129.163$$

$$Rt = ((((-129.163Tc) + 13698.3)^{-1}) - (23100)^{-1})^{-1}$$

Where: Tc = Temp (deg C
RT = RCAL

TABLE 3.1B

MODELS 060A-2, 063-1, 064-2

TEMP DEG F	RNOM*	RCAL	TEMP DEG F	RNOM*	RCAL
-58	20156.406	158178.396	1	15922.743	51247.345
-57	20084.649	153864.473	2	15850.986	50511.390
-56	20012.892	149751.096	3	15779.229	49789.864
-55	19941.135	145824.598	4	15707.472	49082.344
-54	19869.378	142072.527	5	15635.715	48388.428
-53	19797.621	138483.513	6	15563.958	47707.726
-52	19725.864	135047.152	7	15492.201	47039.866
-51	19654.107	131753.909	8	15420.444	46384.486
-50	19582.350	128595.024	9	15348.687	45741.240
-49	19510.593	125562.439	10	15276.930	45109.795
-48	19438.836	122648.729	11	15205.173	44489.828
-47	19367.079	119847.038	12	15133.416	43881.030
-46	19295.322	117151.028	13	15061.659	43283.101
-45	19223.565	114554.830	14	14989.902	42695.752
-44	19151.808	112053.002	15	14918.145	42118.707
-43	19080.051	109640.490	16	14846.388	41551.694
-42	19008.294	107312.596	17	14774.631	40994.456
-41	18936.537	105064.943	18	14702.874	40446.742
-40	18864.780	102893.455	19	14631.117	39908.309
-39	18793.023	100794.323	20	14559.360	39378.924
-38	18721.266	98763.991	21	14487.603	38858.361
-37	18649.509	96799.130	22	14415.846	38346.400
-36	18577.752	94896.625	23	14344.089	37842.831
-35	18505.995	93053.552	24	14272.332	37347.448
-34	18434.238	91267.171	25	14200.575	36860.054
-33	18362.481	89534.904	26	14128.818	36380.456
-32	18290.724	87854.331	27	14057.061	35908.471
-31	18218.967	86223.170	28	13985.304	35443.916
-30	18147.210	84639.274	29	13913.547	34986.620
-29	18075.453	83100.619	30	13841.790	34536.411
-28	18003.696	81605.292	31	13770.033	34093.128
-27	17931.939	80151.490	32	13698.276	33656.612
-26	17860.182	78737.507	33	13626.519	33226.708
-25	17788.425	77361.727	34	13554.762	32803.268
-24	17716.668	76022.625	35	13483.005	32386.147
-23	17644.911	74718.752	36	13411.248	31975.205
-22	17573.154	73448.737	37	13339.491	31570.305
-21	17501.397	72211.277	38	13267.734	31171.314
-20	17429.640	71005.136	39	13195.977	30778.106
-19	17357.883	69829.141	40	13124.220	30390.554
-18	17286.126	68682.175	41	13052.463	30008.538
-17	17214.369	67563.176	42	12980.706	29631.940
-16	17142.612	66471.134	43	12908.949	29260.645
-15	17070.855	65405.087	44	12837.192	28894.542
-14	16999.098	64364.116	45	12765.435	28533.523
-13	16927.341	63347.348	46	12693.678	28177.483
-12	16855.584	62353.948	47	12621.921	27826.320
-11	16783.827	61383.120	48	12550.164	27479.933
-10	16712.070	60434.103	49	12478.407	27138.227
-9	16640.313	59506.170	50	12406.650	26801.107
-8	16568.556	58598.626	51	12334.893	26468.481
-7	16496.799	57710.807	52	12263.136	26140.260
-6	16425.042	56842.076	53	12191.379	25816.357
-5	16353.285	55991.825	54	12119.622	25496.688
-4	16281.528	55159.469	55	12047.865	25181.169
-3	16209.771	54344.451	56	11976.108	24869.721
-2	16138.014	53546.233	57	11904.351	24562.266
-1	16066.257	52764.302	58	11832.594	24258.727
0	15994.500	51998.163	59	11760.837	23959.029

*VALUE WITH A 23.1K RESISTOR IN PARALLEL WITH SENSOR

RANGE = -58 TO +122 DEGREE FARENHEIT
THERMISTOR BEAD = 44212
RNOM = (-71.757)T +15994.5 WHERE T = TEMPERATURE IN DEGREE FARENHEIT

TABLE 3.1B

MODELS 060A-2, 063-1, 064-2

TEMP DEG F	RNOM*	RCAL	TEMP DEG F	RNOM*	RCAL
60	11689.080	23663.101	101	8747.043	14077.705
61	11617.323	23370.871	102	8675.286	13892.761
62	11545.566	23082.271	103	8603.529	13709.648
63	11473.809	22797.233	104	8531.772	13528.339
64	11402.052	22515.693	105	8460.015	13348.808
65	11330.295	22237.585	106	8388.258	13171.028
66	11258.538	21962.848	107	8316.501	12994.973
67	11186.781	21691.420	108	8244.744	12820.620
68	11115.024	21423.243	109	8172.987	12647.942
69	11043.267	21158.258	110	8101.230	12476.917
70	10971.510	20896.408	111	8029.473	12307.521
71	10899.753	20637.639	112	7957.716	12139.730
72	10827.996	20381.896	113	7885.959	11973.522
73	10756.239	20129.126	114	7814.202	11808.874
74	10684.482	19879.278	115	7742.445	11645.765
75	10612.725	19632.301	116	7670.688	11484.173
76	10540.968	19388.147	117	7598.931	11324.077
77	10469.211	19146.767	118	7527.174	11165.457
78	10397.454	18908.114	119	7455.417	11008.292
79	10325.697	18672.142	120	7383.660	10852.561
80	10253.940	18438.806	121	7311.903	10698.247
81	10182.183	18208.063	122	7240.146	10545.329
82	10110.426	17979.869			
83	10038.669	17754.182			
84	9966.912	17530.962			
85	9895.155	17310.168			
86	9823.398	17091.760			
87	9751.641	16875.700			
88	9679.884	16661.951			
89	9608.127	16450.476			
90	9536.370	16241.238			
91	9464.613	16034.203			
92	9392.856	15829.335			
93	9321.099	15626.601			
94	9249.342	15425.968			
95	9177.585	15227.402			
96	9105.828	15030.873			
97	9034.071	14836.350			
98	8962.314	14643.801			
99	8890.557	14453.196			
100	8818.800	14264.507			

*VALUE WITH A 23.1K RESISTOR IN PARALLEL WITH SENSOR

RANGE = -58 TO +122 DEGREE FARENHEIT
THERMISTOR BEAD = 44212
RNOM = (-71.757)T +15994.5 WHERE T = TEMPERATURE IN DEGREE FARENHEIT

Wind Direction Sensor

024A

The Model 024A Wind Direction Sensor is an accurate, durable and economical sensor suitable for a wide range of wind study applications. It is designed for long-term unattended operation in most meteorological environments.

Features

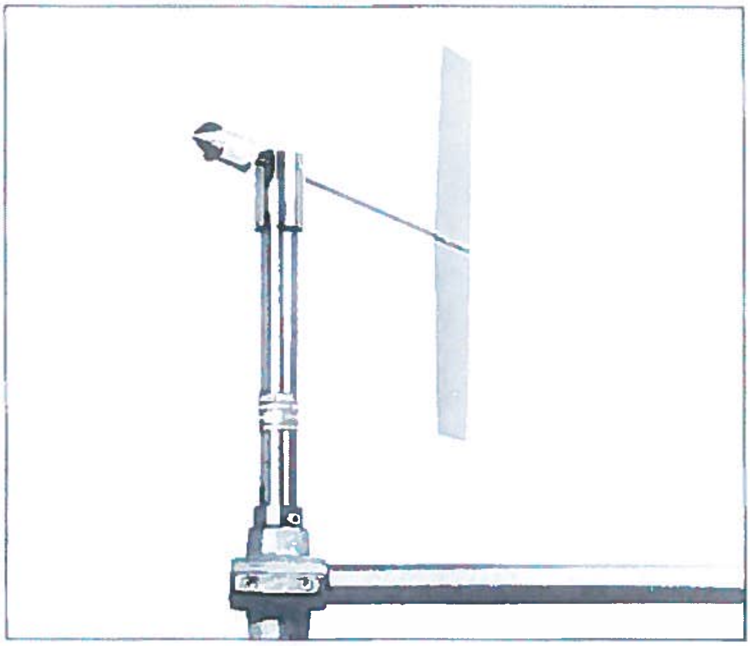
- Range to 100 mph
- Low starting threshold
- Broad temperature operating range
- Built-in alignment and calibration feature
- Accuracy of ±5°
- Stainless steel and aluminum construction

Operation

The sensor incorporates a precision wire-wound potentiometer for accurate resolution of wind direction. The potentiometer is directly coupled to the vane assembly. Variations in wind direction produce a corresponding varying voltage, which lends itself to both digital and analog measurement systems.

Construction

The construction of the sensor reflects the requirement for reliability and durability. Only the best corrosion resistant materials, such as stainless steel and anodized aluminum are used. The potentiometer meets stringent military specifications for sand, dust, salt spray and fungus resistance. The Model 024A sensor uses a quick-connect sensor cable. Cable length may extend hundreds of feet without affecting measurement performance.



Accuracy, reliability and economy make the model 024A Wind Direction Sensor an ideal choice for most applications.

Specifications

Range	0-360°
Starting threshold	1 mph
Accuracy	±5°
Delay distance	<5 feet
Damping ratio	
Standard	0.25 (metal vane ass'y)
Fast Response	0.4 (foam vane ass'y)
Potentiometer	
Sand, dust, fungus	MIL-E-5272
Salt spray	MIL-E-12934
Electrical range	0-360° 0-540° with appropriate translator
Operating range	-50° C to +70° C
Weight	1 lb 2 oz
Mounting	Model 191 Cross Arm

Ordering Information

Standard Model	024A (Metal Vane)
Fast Response Model	024A-1 (Foam Vane)
Cable	#1806-xx (xx = length in feet)

Met One Instruments, Inc.
Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

MODEL 024A
WIND DIRECTION SENSOR

OPERATION MANUAL
Document No. 024A-9800

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

024 WIND DIRECTION SENSOR
OPERATION MANUAL

1.0 GENERAL INFORMATION

1.1 The Met One 024A Wind Direction Sensor uses a lightweight, air-foil vane and a potentiometer to produce an output that varies proportional to wind direction.

1.2 The Sensor Cable has a quick-connect connector with vinyl-jacketed, shielded cable. Cable length is given in -XX feet on each cable part number. An 1806-XX cable is used with translators having terminal strip connections, and an 1809-XX cable is used with translators having circular MS type connectors.

TABLE 1-1
Model 024A Wind Direction Sensor Specifications

Performance Characteristics	
Azimuth	Electrical 0-356°*
	Mechanical 0-360°
Threshold	1.0 mph
Accuracy	±5°
Damping Ratio	Standard 0.25
	Optional 0.4
Potentiometer Specs.	
	Sand, Dust, Fungus MIL-E-5272
	Salt Spray MIL-E-12934
Temperature Range	-50° C to +70° C
Delay Distance	5 ft.
Electrical Characteristics	
Output Signal	Varying resistance 0-10 K ohms
Physical Characteristics	
Weight	1.5 pounds
Finish	Anodized
Mounting Fixtures	Use with 191 Crossarm
Cabling	3-Conductor Shielded
	Type Cable, xx is cable length in feet

CAUTION: THIS POTENTIOMETER HAS A SHORTING GAP WIPER. ANY VOLTAGE APPLIED TO THE SENSOR MUST BE CURRENT LIMITED TO 5 MILLIAMPS.

2.0 INSTALLATION

2.1 024A Wind Direction Sensor Installation (See FIGURE 2-1)

A. Prior to installing the wind direction sensor on the crossarm remove the stainless steel screw from the hub and rotate the vane assembly slowly. It should rotate smoothly without hesitation or binding. Inspect the vane assembly to be sure it is not bent or damaged. Replace the screw in the hub.

B. Install the sensor in the bushing end of the mounting arm. The screw in the bushing will pass through the bushing and will tighten into the sensor housing.

C. Loosen the two set screws holding bushing and orient the sensor so that the counterweight is pointing south. The use of a transit/compass will assure accurate alignment. When the sensor is properly aligned tighten the crossarm fitting set screws and remove the stainless steel screw from the hub. The sensor may be removed and replaced without realignment by removing the mounting screw in the alignment bushing.

D. Remove and retain shoulder screw (11). Check to see that the vane assembly rotates freely.Rotate the sensor assembly until the counterweight is pointing due south.

E. Connect the cable assembly to the keyed sensor receptacle and tape it to the mounting arm.

2.2 Wiring. The cable assembly contains three wires. Typical wiring hookup is shown in FIGURE 2-1.

2.3 Lightning Protection. Weather sensors are sensitive to direct or nearby lightning strikes. A well-grounded metal rod or frame should be placed above the sensor installation. In addition, the shield on the signal cable leading to the translator must be connected to be a good earth ground at the translator end, and the cable route should not be vulnerable to lightning.

3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 024 Wind Direction Sensor Check-Out

A. Rotating the vane in a clockwise direction as viewed from above will increase the output up to the 360° point and it will start over 0°.

B. The 024A wind direction sensor should be inspected periodically for physical damage to the vane assembly and cable connections. Inspect all vane assembly parts to be sure that they are securely fastened. Inspect the sensor connector and mating cable connector for corrosion.

4.0 MAINTENANCE

4.1 General Maintenance Schedule*

6-12 Month Intervals:

A. Inspect sensor for proper operation per Section 3.0.

24-36 Month Intervals:

A. Factory replacement of potentiometer per Section 4.

B. Recommended complete factory overhaul of sensor.

4.2 POTENTIOMETER REPLACEMENT

4.3 Remove the sensor from the crossarm and remove the vane assembly. Replacement of the potentiometer will require realignment with respect to 180 degrees. Use the following procedure to replace and realign the potentiometer.

A) Loosen the three set screws which hold the potentiometer in the sensor housing. Pull the potentiometer up and out of the housing.

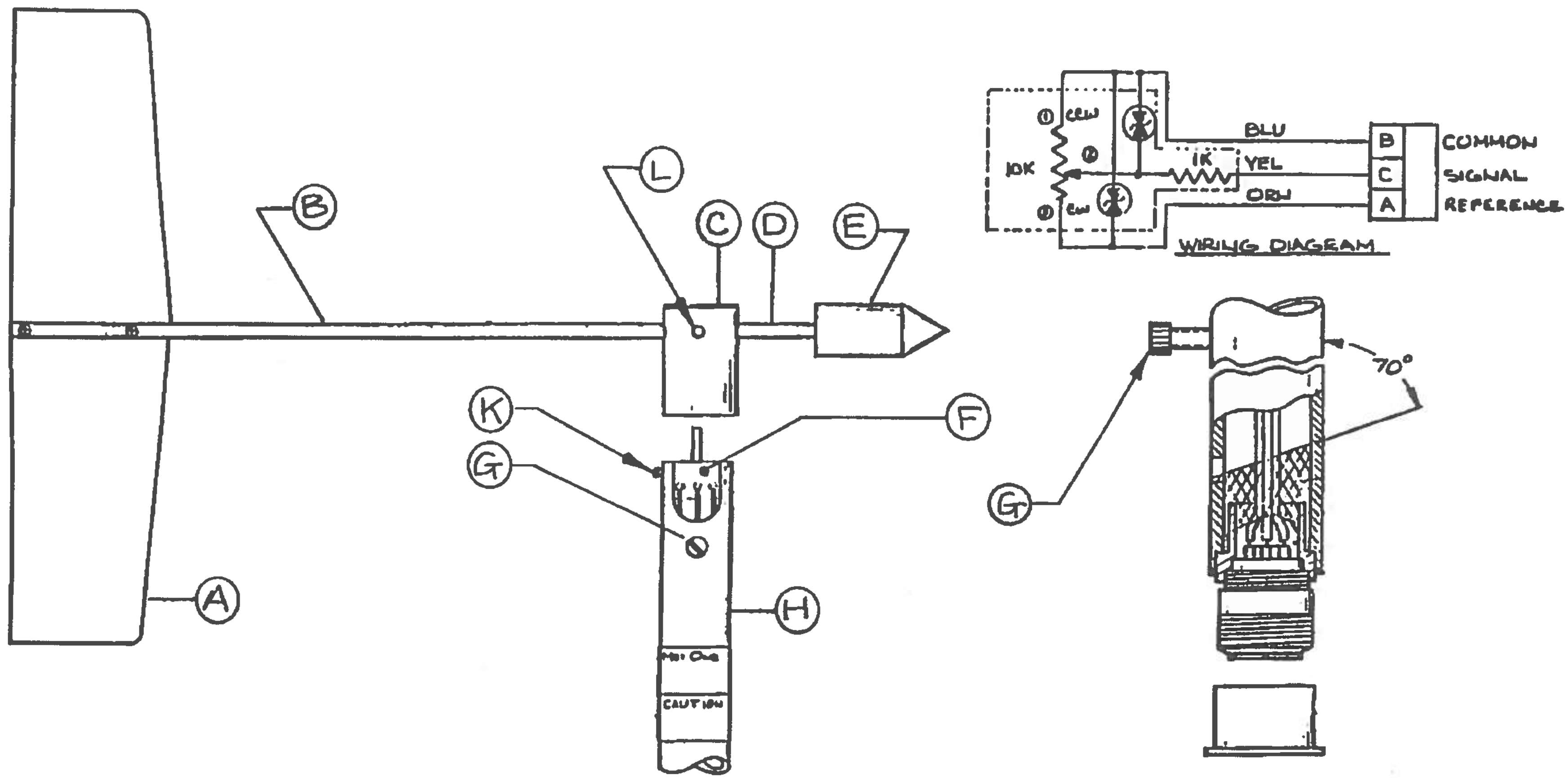
B) Remove the three wires from the potentiometer assembly. Note the color code of the wires with respect to the pins on the potentiometer. (See the 024A Assy. Dwg.)

C) Solder the wires to the new potentiometer and install the potentiometer in the sensor housing.

D) Connect the ohmmeter across pins B and C on the sensor connector. Install the vane assembly and the stainless steel hub alignment screw. Do not tighten the two hub set screws at this time. Insert a small screwdriver in the access hole in the top of the hub and rotate the potentiometer until the resistance measured across pins B and C is equal to the resistance across pins A and C (approx. 6k ohms). Tighten the two set screws carefully. The potentiometer position will tend to move slightly as these screws are tightened.

4.4 RECOMMENDED SPARE PARTS LIST (Refer to Drawing #024A)

Ref	Part No.	Description
A	2089	Aluminum Vane
B	2088	Vane Arm for Aluminum Vane
A,B	1286	Foam Vane and Arm Assy
C	1685-10	Hub
D	1814-1	Counterweight Arm for Aluminum Tail
D	1814-2	Counterweight Arm for Foam Tail
E	1057	Counterweight
A-E	2105	Aluminum Vane Assy, Complete
A-E	2106	Foam Vane Assy, Complete
F	2017	Potentiometer Assy
G	860015	Shoulder Screw
-	601625	8-32 x1/4 Set Screw
L	601680	8-32 x 3/8 Set Screw
K	601070	2-56 x 1/8 Screw



Wind Direction Sensor Model 024A

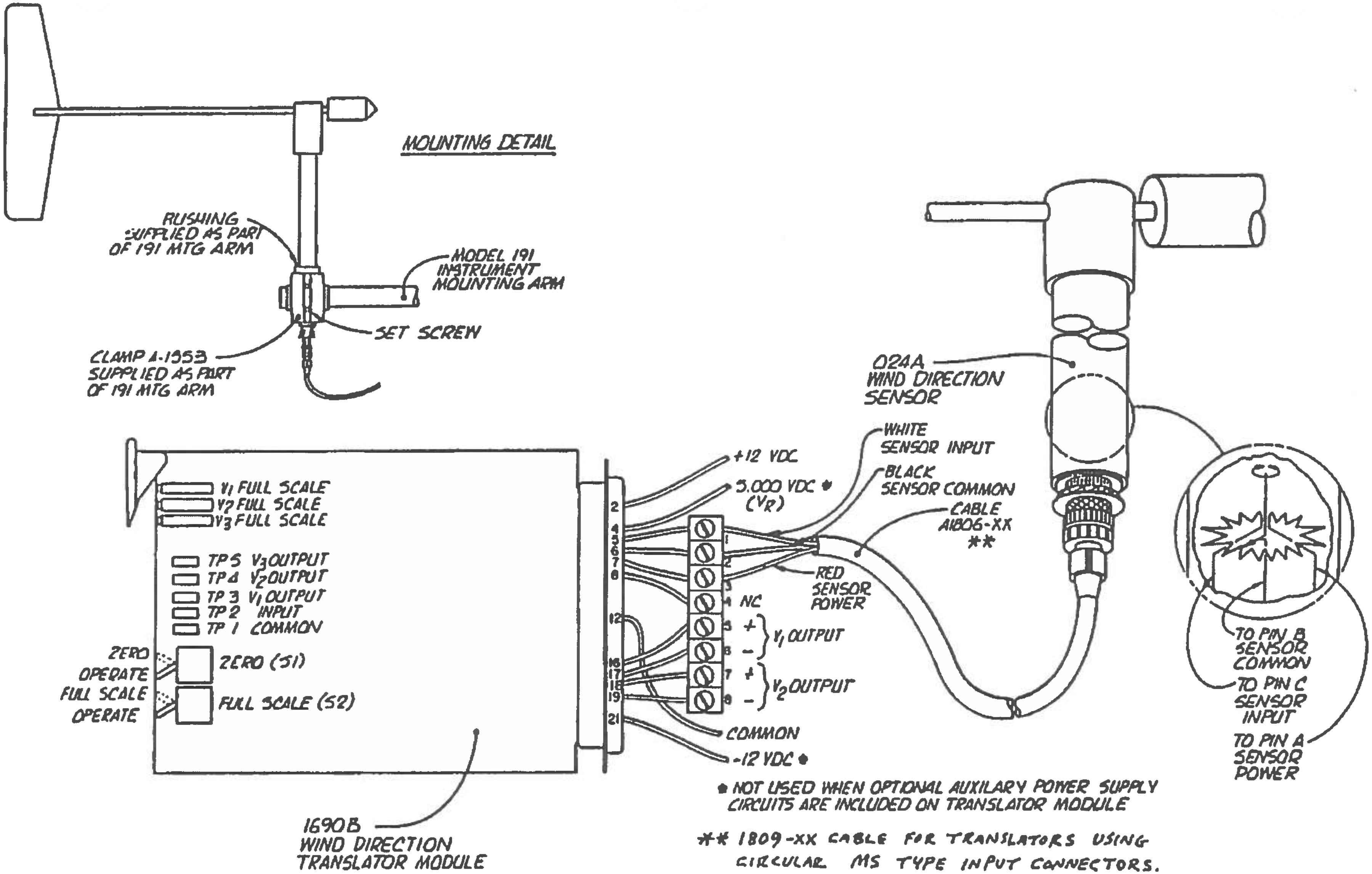
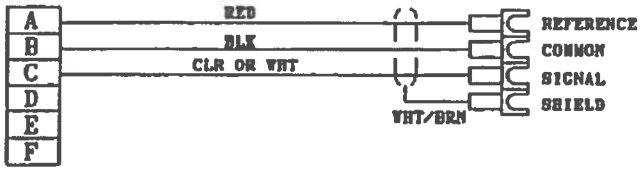


FIGURE 2-1. TYPICAL 024A INSTALLATION

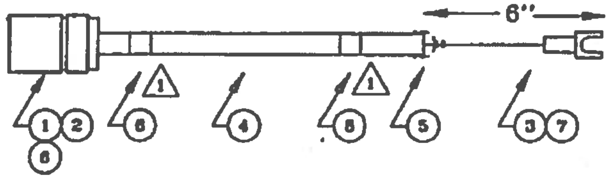
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REDRAWN PER E.O. 1131	9/11/91	DH
E	WIRE COLORS	10/17/91	DH

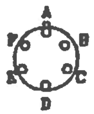


ITEM	PART NO.	DESCRIPTION	QTY
1	500351	CONNECTOR, 6 PIN, FEMALE	1
2	460500	CLAMP	1
3	600193	LUG, SPADE, #6	4
4	400011	CABLE, 3 WIRE, SHIELDED	A/R
5	960050	SLEEVING, 1/4", SHRINK	A/R
6	960075	SLEEVING, 1/8", SHRINK	A/R
7	960510	WIRE, 22 AWG, WHT/BRN	6"
8	960060	SLEEVING, 1/4", CLEAR SHRINK	A/R
9			
10			

SENSOR END

TRANSLATOR END





SOLDER CUP VIEW

△1 IDENTIFY CABLE 16" FROM EACH END.
DASH NUMBER = LENGTH IN FEET.

	MET ONE INSTRUMENTS
	ASSY, CABLE, 024 WIND DIRECTION SENSOR
	SIZE · FSCM NO. · DWG NO. 1806 · REV E
	SCALE · SHEET 1 OF 1

Evaporation Gauge

550502

Features

- Simple data collecting
- High resolution
- Analog output
- Corrosion resistant
- Range 0-8"

The Model 550502 Evaporation Gauge measures the water level in a standard U.S. Class A evaporation pan (Model 550501) and provides an output proportional to that level. The gauge employs a uniquely balanced sensor assembly to allow high resolution and simple data collection without hook gauge readings and time consuming, frequent visits to the site.

The sensor assembly includes one polypropylene float which rises and falls with the water level in the pan. The movement of the float is transferred to a 5K-ohm potentiometer by means of a rack and gear assembly. The mechanism is designed to eliminate backlash. The output range is 0 to 8 inches, with a measuring accuracy of 1%.

Movement of the float assembly also moves a pointer over an indicating scale for convenient water level checks and comparison to output device readings. The scale is graduated in English units on one side and metric units on the other.

The potentiometer output can be input directly to a data acquisition system. Alternately, it can be input to a signal conditioning module.

Evaporation Pan

It is constructed of low carbon stainless steel and is heliarc welded. The pan is normally installed on a level wooden platform set on the ground.

Specifications

Sensor: Single-float assembly on vertical guide rods.
Transducer: 5K-ohm potentiometer
Range: 0-8"
Resolution: Infinite
Accuracy: 1% (with clean guide rods)
Potentiometer linearity: ±0.5%
Cable: 3 conductor shielded, 50' provided
Weight/shipping: 7.5/10 lbs

Met One Instruments, Inc.
Corporate Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (541) 471-7111, Fax (541) 471-7116
Distribution & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (972) 412-4747, Fax (972) 412-4716
http://www.metone.com

MODEL 550502
EVAPORATION GAUGE

OPERATION MANUAL
DOCUMENT 550502-9800

Met One
Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 972-412-4715
Facsimile 972-412-4716

Model 550502 Evaporation Gauge
Operation Manual

1.0 INTRODUCTION

1.1 Description

The Model 550502 Analog Output Evaporation Gauge was designed to accurately measure the changing water level in an evaporation pan and provide an electrical signal proportional to the water level from which the evaporation rate can be determined. Although it can be used with a wide variety of evaporation systems, it is normally used with a standard Class A, National Weather Service evaporation pan. The gauge consists of a float, pulley, and counterweight attached to a precision 1000 ohm potentiometer, all mounted in a protective enclosure.

1.2 Specifications

Gauge

Electrical Output Range	0-9.73" = 0-5 Vdc
Water Level Range	0-8.0" = 0-4.11 Vdc
Height	27-1/2"
Diameter	8"
Weight	7-1/2 lbs.
Cable	#5883-x (x is length in feet) Specify length when ordering cable.
Connector	3 pin MS-type
Float	5" diameter
Counterweight	4 oz
Water input port	1/"" NP coupling, female
Base dimensions	16' triangle with leveling screws
Total resolution	0.0382" with 8-bit converter in datalogger

Potentiometer

Accuracy	1%
Rotation	Continuous
Resistance	1000 ohms, standard
Operating Temperature	-50° to +125°F
Linearity	0.25%
Power	5 Vdc reg

2.0 INSTALLATION

2.1 After carefully unpacking all components, inspect for damage that may have occurred in shipment. Do not discard any packing material until you are certain there is no damage and all items are accounted for, including accessories. In the event of damage during shipment, a claim for loss should be filed with carrier at the receiving location.

2.2 Remove the top cap and remove the float, chain, and counterweight which are packed in the housing for shipping.

2.3 The gauge is connected to the pan by using 1/2" diameter pipe. Flexible tubing is acceptable provided it is not subject to deterioration. The gauge should be placed far enough away from the pan so that it will not cast a shadow on the pan that could have an effect on the evaporation process.

2.4 Level gauge by placing a level on the housing in front of the gear and adjusting the leveling screws on the triangular base until the unit is level.

2.5 After connecting the gauge to the pan and securing all electrical connections, fill evaporation pan with 8" of water and carefully check all joints for leaks.

2.6 The pulley and the potentiometer housing have been marked with indicators that line up when the potentiometer is approximately at the breakpoint between zero and 1000 ohms resistance. To obtain the exact breakpoint for zeroing or base setting, use an ohmmeter across the white and red wires or use the actual readout device that will be used with the unit when in operation.

2.7 The float chain should be placed on the pulley so that the float rests on the top of the water (8" in the evaporation pan) when the pulley is at the breakpoint. For operation, the float chain is placed on the pulley so that a falling level of water will cause clockwise (as seen from the front of the pulley) motion in the pulley and a decrease in resistance in the potentiometer output. Refer to the assembly diagram.

2.8 Carefully secure housing cover into place with allen screws.

3.0 OPERATION

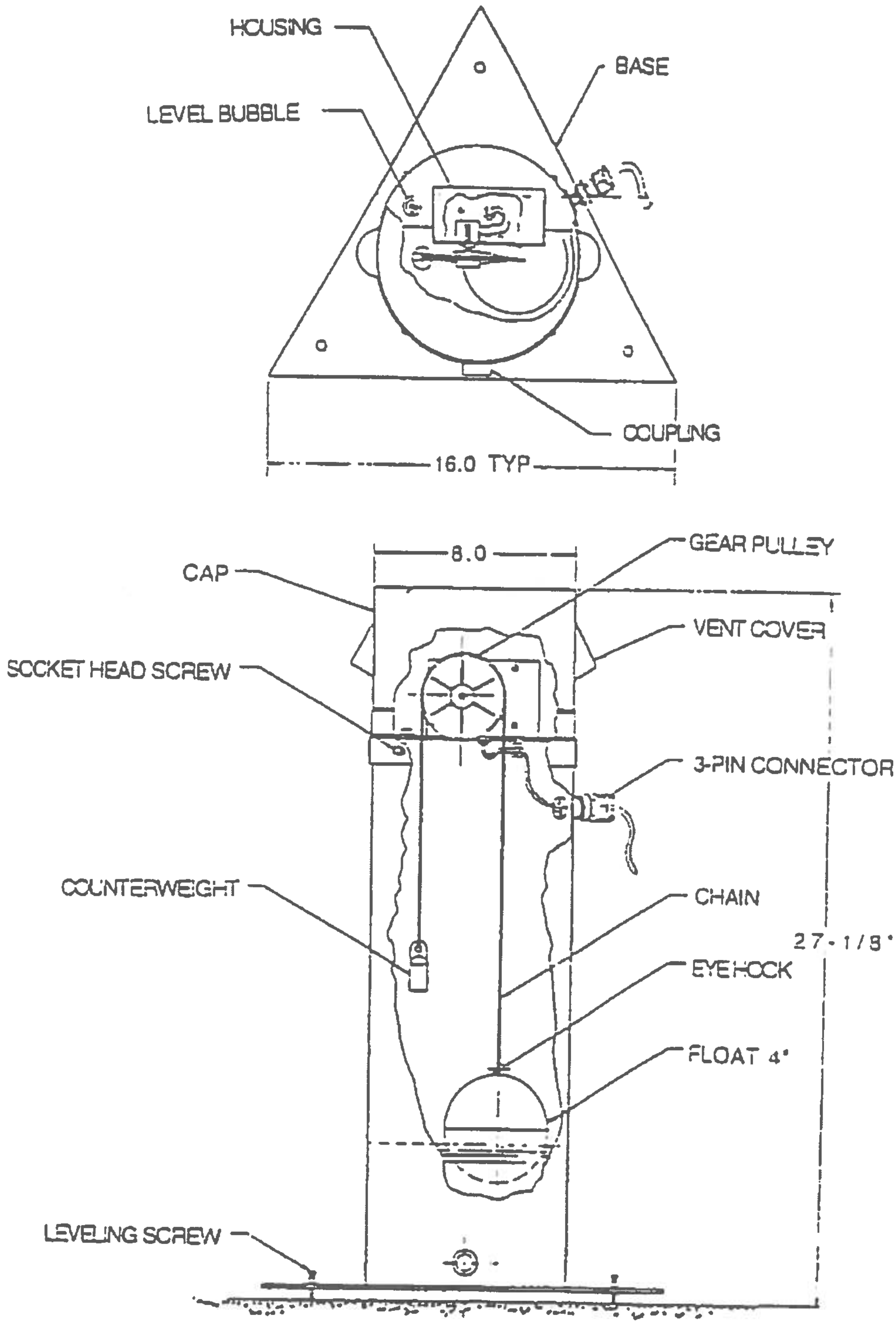
The potentiometer produces a proportional output in relation to the position of the float and can be monitored on site with a datalogger or strip chart recorder.

4.0 TROUBLESHOOTING

4.1 Always disconnect the reporting/recording device from power or troubleshoot immediately whenever any of the following conditions are observed: the cable has been damaged, the gauge does not appear to operate normally or exhibits a marked change in performance, the gauge has been dropped or damaged, or it moisture damage has occurred to the circuits.

4.2 If the gauge does not register correctly, first check the connections. Check the potentiometer with a voltmeter. Be sure the reporting/recording device has been powered-up correctly. If the reporting/recording device uses batteries for its primary source of power, check that the batteries have sufficient voltage to power the device.

4.3 Check the sensor cable connections both at the gauge and at the control unit. Cable shorts can cause lack of readings. If a connection is found to be lose, tighten into place and check to see if the problem has been corrected.



500502 EVAPORATION GAUGE ASSEMBLY

WeatherHawk Series 500 Specifications

Weather Station

Temperature Range:	-40 to +122F (-40 to +50C)
Data Storage:	60 days of hourly data
I/O:	Direct connection RS232
	Optional Wireless RF
I/O Data Rate:	9600 baud
Wireless Frequency:	Spread Spectrum 916 MHz
Battery:	Integrated 2.9 AHr Lead-Acid GelCel
Charging Voltage:	16 t0 22 VDC
Current Drain:	10 mA w/o heater
	1.1 A with heater

Sensors

Air Temperature:		Capacitive ceramic
	Range	-60 to +140F (-52 to +60 C)
	Accuracy:	+/-0.9 F @ -40 to 125 F (+-0.5 C @-40 to 52 C)
	Resolution:	0.1 F (0.1 C)
Relative Humidity:		Capacitive thin-film polymer
	Range	0-100%
	Accuracy:	+/- 3% @ 0-90%RH; +/- 5% @ 90-100%RH
	Resolution:	0.1%
Barometric Pressure:		Capacitive Silicon
	Range:	17.72-32.48 inHg (60-110 kPa)
	Accuracy:	.015 inHg @+32 to +86 F (+-.05 kPa @0-32 C)
	Resolution:	.03 inHg @-60 to +140 F (+-.1 kPa @-52 to +60 C)
Solar Radiation:		Silicon pyranometer
	Spectral Range	300 to 1100 nm
	Reproducibility	+/-2%
	Output	.2 mV per W/m^2
	Range	0 to 1000 W/m^2
	Temp. Range	-40 to 130 F (-40 to +55 C)
Rain:		Piezoelectric
	Collecting Area	9.3 in^2 (60 cm^2)
	Range	0 to 7.87 in/hr (0 to 200 mm/hr)
	Accuracy:	<5% (weather dependant)
	Resolution	.001 in (.01 mm)
Wind Direction:		Ultrasonic
	Azimuth:	0-360 deg
	Response Time:	250 ms
	Accuracy:	+- 2 deg
	Resolution:	1 deg
Wind Speed:		Ultrasonic
	Range:	0-134 mph (0-60 m/s)
	Response Time:	.25 s
	Accuracy:	+-.67 mph (+- 0.3m/s) or +-2% which ever is greater
	Resolution:	.22 mph (0.1 m/s)

WeatherHawk, 185 West 1800 North, Logan, UT
International: 435-750-1802 TOLL FREE USA: 866-670-5982 FAX: 435-750-1749
http://www.weatherhawk.com sales@weatherhawk.com

WeatherHawk Series 500

General Description:

The WeatherHawk Series 500 family of weather stations measure and record wind speed and direction, air temperature and relative humidity, barometric pressure, solar radiation, and rain. In addition, the system calculates and exports an evapotranspiration (ET) value that can be used by third party systems for irrigation control. They are designed for applications where a minimal visual impact, high reliability, and a long interval between routine servicing are significant factors in the decision to purchase. The standard Series 500 system incorporates an integral 3 AHr battery pack and can be interfaced with an optional solar panel for high reliability applications.

The Series 500 family is fully compatible with all versions of software, data management, input power and mounting accessories designed for the WeatherHawk Signature Series. It is also backwards compatible with all third party certified software drivers.

The Series 500 WeatherHawk systems utilize solid state sensors, with no moving parts. Solid state sensors enable a low profile design better suited to high visibility locations where a traditional weather station would be visually objectionable; they have higher reliability and a longer interval between routine service and inspection requirements; they are more robust and less susceptible to damage from wind carried debris; and they are not impaired by heavy snowfall or freezing conditions that produce rime ice (NOTE: Heated sensor versions, Models 511/521, must be used in snow or freeze zone applications).

Models 510/511

These versions of the Series 500 weather station are directly connected to a host device (PC or server) through an RS232 serial data I/O located on the bottom of the weather station. The Model 511 incorporates a thermostatically controlled heater element in the sensor head that keeps the ultrasonic wind sensor elements and the piezometric precipitation sensor surface free of snow and ice to –52° C.

Models 520/521

These versions of the Series 500 weather station are wireless to a host device (PC or server) using fully integrated industrial grade 916 MHz spread spectrum RF communications technology. They also have an RS232 serial data I/O located on the bottom of the weather station, which can be used as a second serial communications port, or for programming and testing the system, or for direct data downloads using a PC or PDA. The Model 521 also incorporates a thermostatically controlled heater element in the sensor head that keeps the ultrasonic wind sensor elements and the piezometric precipitation sensor surface free of snow and ice to –52° C. Optional configurations of both units enable replacement of the 916 MHz RF components with 922 MHz and 2.4 GHz RF components to comply with local, regional or national radio frequency licensing requirements.

WeatherHawk, 185 West 1800 North, Logan, UT
International: 435-750-1802 TOLL FREE USA: 866-670-5982 FAX: 435-750-1749
http://www.weatherhawk.com sales@weatherhawk.com

Sensor Technologies

Series 500 WeatherHawk weather stations employ the latest in weather measurement sensors. Wind speed and direction use acoustic techniques formerly available on only the most expensive professional wind velocity measurement systems. Rain is measured using an impact surface that literally counts the raindrops and measures their acoustic signature, integrating that information to provide a near real-time value for rainfall amount and rate. Barometric pressure, relative humidity, air temperature and solar radiation measurements are made by calibrated scientific grade sensors typically installed in the finest professional weather measurement and monitoring systems.

Wind Speed & Direction is measured by a sensor consisting of three equally spaced ultrasonic transducers in a horizontal plane. The sensor measures the bi-directional transit time along the three paths established by the transducer array. This transit time is dependent on the wind velocity across the ultrasonic path. For zero wind velocity, both the forward and reverse transit times are identical; with wind, the upwind transit time increases and the downwind time decreases. The values of any two array paths will enable computation of both wind speed and direction, and a signal processing technique enables the measurement to be calculated using the two array paths of the best quality. If the system is used in a high accuracy application a factory revalidation is recommended every five years.

Rainfall is measured with a stainless steel piezometric surface on top of the weather station. As individual raindrops (or hailstones) impact on the surface they each provide an acoustic signature that is measured and processed in real-time to give a value for their volume. The volume is then processed with respect to time to provide a rainfall rate. This measurement technique eliminates all of the traditional problems with tipping bucket type rainfall measurement devices, including worn or damaged bearings, clogged funnels and drip orifices, and damage from wind blown debris.

Air temperature and relative humidity (RH) sensors are combined in an integrated, user replaceable unit that requires no calibration. The RH sensor is a thin polymer, capacitive type sensor that degrades with exposure due to age and airborne contaminates. It should be user replaced every three years to maintain accuracy, and at a shorter interval if the location is subject to high levels of air pollution or is subject to airborne chemical spraying. The air temperature sensor is a capacitive ceramic sensor that is typically not subject to environmental degradation.

Barometric pressure is measured with a capacitive silicon temperature corrected strain gauge device that is typically not degraded by environmental exposure and does not require calibration after manufacture.

Solar Radiation is measured by a silicon pyranometer with a cut filter limiting the spectral exposure to the 300-1100 nm wavelength. This device typically degrades at a rate of 2% of the full scale value each year and should be recalibrated, or replaced every 3-5 years, depending on the application.

Data Transfer Protocols, Software and Data Interface Hardware

All WeatherHawk systems communicate using a proprietary Pakbus protocol. Any qualified software developer may request a software development kit, at no charge, to assist in the development of software drivers for third party devices or software.

WeatherHawk, 185 West 1800 North, Logan, UT
International: 435-750-1802 TOLL FREE USA: 866-670-5982 FAX: 435-750-1749
http://www.weatherhawk.com sales@weatherhawk.com

Software

WeatherHawk offers the following software applications for weather station management, data acquisition and logging, report generation and data display.

- *Visual Weather Station* – a single host, multi-site professional application that will communicate with any WeatherHawk weather station, as well as CR200 Series data loggers from Campbell Scientific, Inc. Visual Weather Station adapts to any data telemetry scheme including direct connection, wireless short haul RF (spread spectrum radio), wireless long-haul RF (VHF/UHF radio), satellite modem, IP modem/server module, or landline and cellular modems. The application also offers a variety of standard and user defined reports and export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on PC-XP computers.
- *WeatherHawk-XP/X* – a single host, single site consumer application that will communicate with any WeatherHawk weather station. WeatherHawk-XP/X connects using a directly to the serial port on the WeatherHawk, or by wireless short haul RF (spread spectrum radio), or IP modem/server module, or landline and cellular modems. The application also offers a three export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on PC-XP and Macintosh OS-X computers. This software application will also interface with the NOAA/NWS CAMEO application for First Responder applications requiring plume modeling.
- *Virtual Weather Station* – a single host, single site consumer application that will communicate with any WeatherHawk weather station. Virtual Weather Station connects directly through the serial port on the WeatherHawk, or by wireless short haul RF (spread spectrum radio). The application also offers a two export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on IBM compatible computers.
- *LoggerNet* – a single host, multi-site professional application that will communicate with any WeatherHawk weather station, as well as any data loggers from Campbell Scientific, Inc. LoggerNet adapts to any data telemetry scheme including direct connection, wireless short haul RF (spread spectrum radio), wireless long-haul RF (VHF/UHF radio), satellite modem, IP modem/server module, or landline and cellular modems. The application also offers a variety of standard and user defined reports and export file formats, and with the RTMC module it will support the generation, export and update of a weather data GUI for a website. This application runs on IBM compatible computers.
- *PConnect* – a single host, single site professional application that will communicate with any WeatherHawk weather station, as well as a range of Campbell Scientific data loggers. PConnect is used for direct download and storage of data through the serial port on either the weather station or its companion RF4xx receiver (if wireless). The software is typically utilized for field data acquisition with later export to a PC for post-processing, display and long-term archiving. It also enables on-site reprogramming of the weather station by uploading pre-configured program files. It is not designed for long haul or automated data collection protocols. This application runs on a range of PDA devices, check with Campbell Scientific, or WeatherHawk for a list of compatible units.

- *Weather Display* – a single host, single site consumer application that will communicate with any WeatherHawk weather station. Weather Display connects directly through to the serial port on the WeatherHawk, or by wireless short haul RF (spread spectrum), or IP modem/server module. The application also offers a range of export file formats, and it will support the generation, export and update of a weather data GUI for a website. This application runs on PC-XP computers.

Data Interface Hardware

Weatherproof serial cables are available in 25, 50 and 75 foot lengths for permanent direct connection to the RS232 I/O on any WeatherHawk weather station. These cables feature nickel plated brass DB-9 connectors for corrosion resistance and have a Sanoprene jacket which is suitable for both high UV and direct burial environments.

An *RF4xx spread spectrum RF transceiver* is supplied as standard equipment with every wireless WeatherHawk weather station. The unit comes with an AC power supply (120 VAC/60 Hz), a 6 foot serial cable and an antenna. Additional RF4xx kits can be purchased for simultaneous communication with any WeatherHawk wireless weather station, enabling multiple host computers to use the data from a single weather station. Typical applications for multiple receiver units are in home automation where a single weather station may support a whole house control unit, with touch panel data display units; and a discrete PC, which may act as the server for a local intranet or internet weather data display website.

WeatherHawk IP server modules are a proprietary web server that is designed to interface the serial output of any WeatherHawk weather station, or companion RF4xx transceiver with an Ethernet. Output formats from the IP server module are HTML, XML and CSV (with headers).

Mounting Systems

All WeatherHawk weather stations will interface with the full range of mounting systems supplied by WeatherHawk. They consist of:

TP-1 Tripod – The tripod, with its range of accessories is the most rugged and adaptive weather station mounting system. It supports both rooftop (sloped and flat) and ground mounts, with mast heights to 10 feet. Accessories consist of a weather station alignment kit (optional), ground stakes (optional), a rooftop sealing kit (standard), grounding rod kit (optional), mast length extensions (optional), and a guy-wire kit (optional).

HM Series – The HM Series house mount kits are adapted satellite dish mounts that will support attachment to sloped and flat roofs, and to the vertical facia and reinforced trim boards around the roofline of a home. The accessories consist of mast extensions, a Retro-deck base assembly that offers additional stability and support on composite roof coverings; and a Comm-deck mount that offers a weatherproof penetration through a roof for a directly connected weather station.

Various additional specialized mounting tripods are available for high environmental abuse environments, or quick deployment temporary applications.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-2.3

Provide complete descriptions of the diversion berms and the collection ditch in the SAR Sections 2.4.1 and 2.4.2, Hydrological Description and Floods, respectively. Please provide the following supplemental information:

a) Exact locations of the diversion berms and the collection ditch;
b) Design Information of the two structures;
c) Impact of the two structures on design basis and PMF floods; and –
d) Impact of the two structures on safety structures of the proposed site

WCS response to RSI 2.3

WCS has provided the requested information in WCS SAR Chapter 2 Section 2.4.2.2.

WCS SAR Impact:

Added to end of WCS SAR Section 2.4.2.2:

The collection ditch is divided into two sections, A and B.

Figure 2-26 (CJI Drawing C-1) show the location of the Collection Ditch and Berm. Figures 2-27 through 2-30 (CJI Drawings C-2, C-3, C-4, and C-5) show plan and profile of the collection ditch and berm.

The diversion berm and collection ditches that will direct storm water runoff from the north around the CISF are designed to convey the peak runoff flow from a 100-year 24-hour rainfall event while still providing 1 foot of freeboard. Surface water runoff peak flow rates are modeled using the U.S. Army Corps of Engineers Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS), version 4.0. The rainfall amount for the 100-year frequency storm event is taken from the *USDA Soil Conservation Service (SCS) Texas Engineering Technical Note No. 210-18-TX5, October 1990 (TETN 210).* A 24-hour storm duration is used. The 100-year 24-hour rainfall amount from *TETN 210* for the CISF site is six (6) inches. The synthetic Type II, 24-hour rainfall distribution for Andrews County, Texas, and the SCS dimensionless unit hydrograph method are used for the model. The Antecedent Runoff Condition modeled is Type I as indicated in *TETN 210.*

Collection ditch A and collection ditch B drain to the west and to the east, respectively, are designed to be trapezoidal bottom ditches with side slopes of 3H:1V. Collection ditch A is designed to have a 3 foot bottom width. Collection ditch B is designed to have a 4 foot bottom width. The ditches are designed with slopes of 0.5%. A value of 0.028 was used for Manning's Roughness Coefficient when performing hydraulic calculations to size the collection ditches.

There will be no adverse impact from the features on the design basis and Probable Maximum Flood (PMF). Since the features were designed to convey storm water runoff from the area north of the CISF and were sized for a 100-year 24 hour rainfall event plus 1 foot of freeboard, the features would not convey all of the runoff during the PMF. However, the features will not cause the PMF elevation near the CISF to increase. As indicated in Section 4.0 of the March

2016 report entitled *Centralized Interim Storage Facility Drainage Evaluation and Floodplain Analysis* (Attachment B of SAR Chapter 2):

"The local PMP floodplain analysis yielded the PMF elevation near the CISF site of 3488.9 ft Mean Sea Level (msl). Elevations of the storage pads vary from 3488 ft msl to 3504 msl. Elevations of the foundations of the security/administration building and the transfer facility are 3496 ft msl and 3493 ft msl, respectively."

Flooding during the PMF would not compromise the safety of the storage cask systems if the berm and the collection ditch were not constructed or if the two structures failed. The berm and collection ditch are provided and sized for a smaller 100 year frequency storm event to minimize storm water from flowing across the site during operations. Flooding caused by the PMF would exceed the capacity of the diversion berm and collection ditch. The flood from the PMF will result in a maximum depth of water over the storage pad of approximately 1 inch. The finish floor elevations of the Security/Administration building and the Cask Handling Building are 7 feet and 4 feet respectively above the PMF elevation and will not be impacted by the PMF.

2.4.2.1 Flood History

The climate of the area is classified as semiarid, characterized by dry summers and mild, dry winters. Annual precipitation on average is approximately 14 inches and annual evaporation exceeds annual precipitation by nearly five times. The area is subject to occasional winter storms, which produce snowfall events of short duration.

Rainfall records from July 2009 through December 2015, provided by WCS from a weather station near the WCS CISF, indicate an average annual rainfall of 12.6 inches and a maximum twenty-four hour rainfall total of 3.62 inches (Attachment A). According to WCS personnel, surface water runoff has not overflowed roads or existing drainage features at the WCS site during this time frame.

2.4.2.2 Flood Design Considerations

There has been no history of flooding at the WCS CISF site and the WCS CISF is not located in the 100-year floodplain. Almost all of the surface water runoff from the storage area will leave the WCS CISF just north of the southeast corner of the storage area and will drain into the large playa southeast of the WCS CISF. A small amount of surface water runoff from the parking lot of the WCS CISF will drain southwest. Flow arrows on Figure 1.1.2-2 in Attachment B, Developed Drainage Area Map, provide the detailed drainage patterns for the WCS CISF.

The WCS CISF Drainage Evaluation and Floodplain Analysis (Attachment B) models the probable maximum flood (PMF) flow over the existing railroad and the proposed WCS CISF rail side track. At analysis Point 1, the peak discharge resulting from all modeled storm events flows over State Line Road. The maximum depth of flow over the road (during the 500-year and ARC III) is approximately 0.8 feet which is equivalent to elevation 3487.3 feet msl. The maximum depth of water on the WCS CISF storage pad for a 500 year flood is 1.1 inches and the velocity is 1.7 feet/s.

The peak discharge resulting from all modeled storm events flows over the railroad tracks at Analysis Point 2. The maximum depth of water over the rail (during 500-year and ARC III) is approximately 1.4 ft. which is equivalent to elevation of 3466.4 feet msl.

The collection ditch is divided into two sections, A and B.

Figure 2-26 (CJI Drawing C-1) show the location of the Collection Ditch and Berm. Figures 2-27 through 2-30 (CJI Drawings C-2, C-3, C-4, and C-5) show plan and profile of the collection ditch and berm.

The diversion berm and collection ditches that will direct storm water runoff from the north around the CISF are designed to convey the peak runoff flow from a 100-year 24-hour rainfall event while still providing 1 foot of freeboard. Surface water runoff peak flow rates are modeled using the U.S. Army Corps of Engineers Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS), version 4.0. The rainfall amount for the 100-year frequency storm event is taken from the *USDA Soil Conservation Service (SCS) Texas Engineering Technical Note No. 210-18-TX5, October 1990 (TETN 210).* A 24-hour storm duration is used. The 100-year 24-hour rainfall amount from *TETN 210* for the CISF site is six (6) inches. The synthetic Type II, 24-hour rainfall distribution for Andrews County, Texas, and the SCS dimensionless unit hydrograph method are used for the model. The Antecedent Runoff Condition modeled is I as indicated in *TETN 210.*

Collection ditch A and collection ditch B drain to the west and to the east, respectively, are designed to be trapezoidal bottom ditches with side slopes of 3H:1V. Collection ditch A is designed to have a 3 foot bottom width. Collection ditch B is designed to have a 4 foot bottom width. The ditches are designed with slopes of 0.5%. A value of 0.028 was used for Manning's Roughness Coefficient when performing hydraulic calculations to size the collection ditches.

There will be no adverse impact from the features on the design basis and Probable Maximum Flood (PMF). Since the features were designed to convey storm water runoff from the area north of the CISF and were sized for a 100-year 24 hour rainfall event plus 1 foot of freeboard, the features would not convey all of the runoff during the PMF. However, the features will not cause the PMF elevation near the CISF to increase. As indicated in Section 4.0 of the March 2016 report entitled *Centralized Interim Storage Facility Drainage Evaluation and Floodplain Analysis* (Attachment B of SAR Chapter 2):

"The local PMP [probable maximum precipitation] floodplain analysis yielded the PMF elevation near the CISF site of 3488.9 ft msl. Elevations of the storage pads vary from 3488 ft msl to 3504 msl. Elevations of the foundations of the security/administration building and the transfer facility are 3496 ft msl and 3493 ft msl, respectively."

Flooding during the PMF would not compromise the safety of the storage cask systems if the berm and the collection ditch were not constructed or if the two structures failed. The berm and collection ditch are provided and sized for a smaller 100 year frequency storm event to minimize storm water from flowing across the site during operations. Flooding caused by the PMF would exceed the capacity of the diversion berm and collection ditch. The flood from the PMF will result in a maximum depth of water over the storage pad of approximately 1 inch. The finish floor elevations of the Security/Administration building and the Cask Handling Building are 7 feet and 4 feet respectively above the PMF elevation and will not be impacted by the PMF.

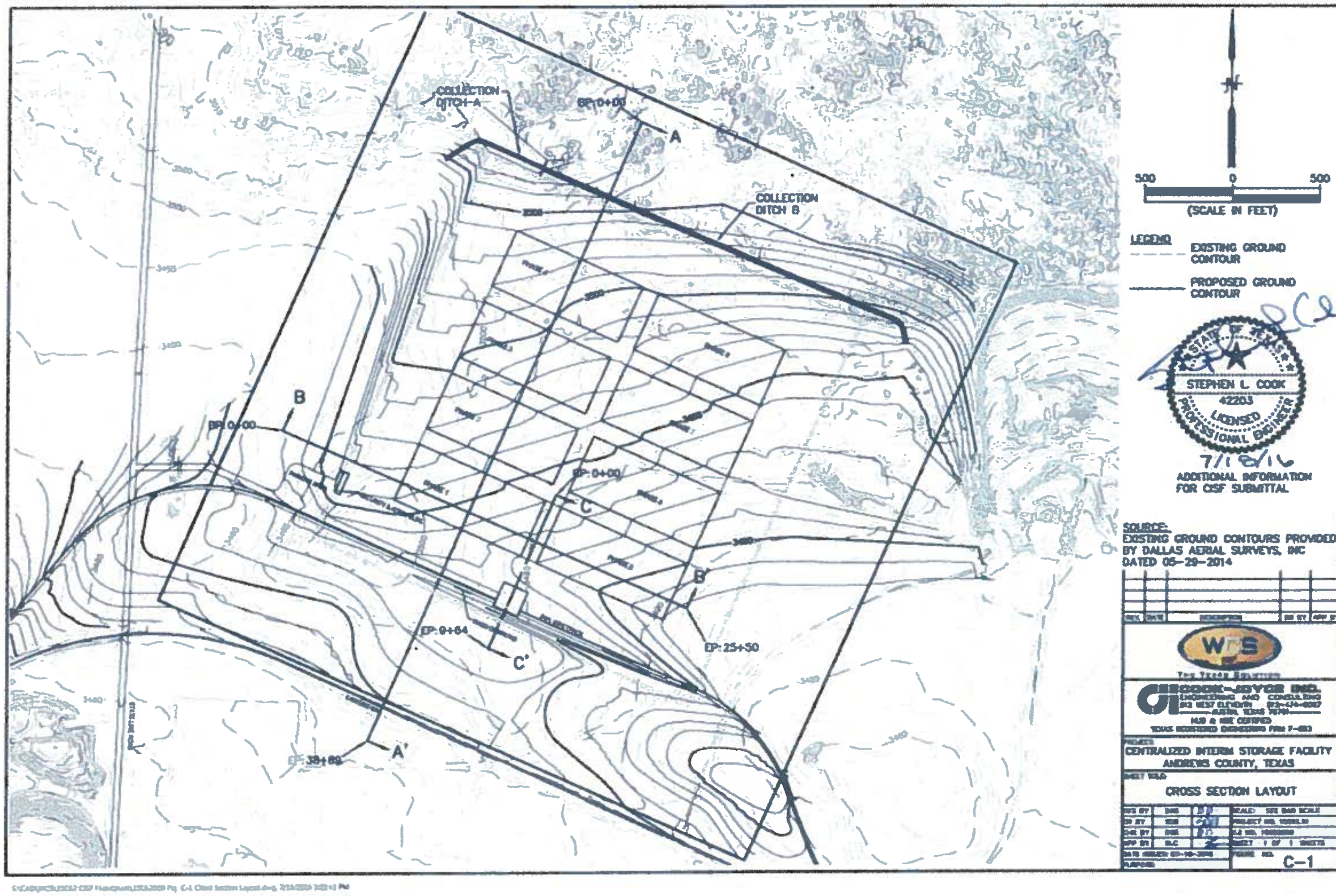


Figure 2-26 CJI C-1 Cross Section Layout

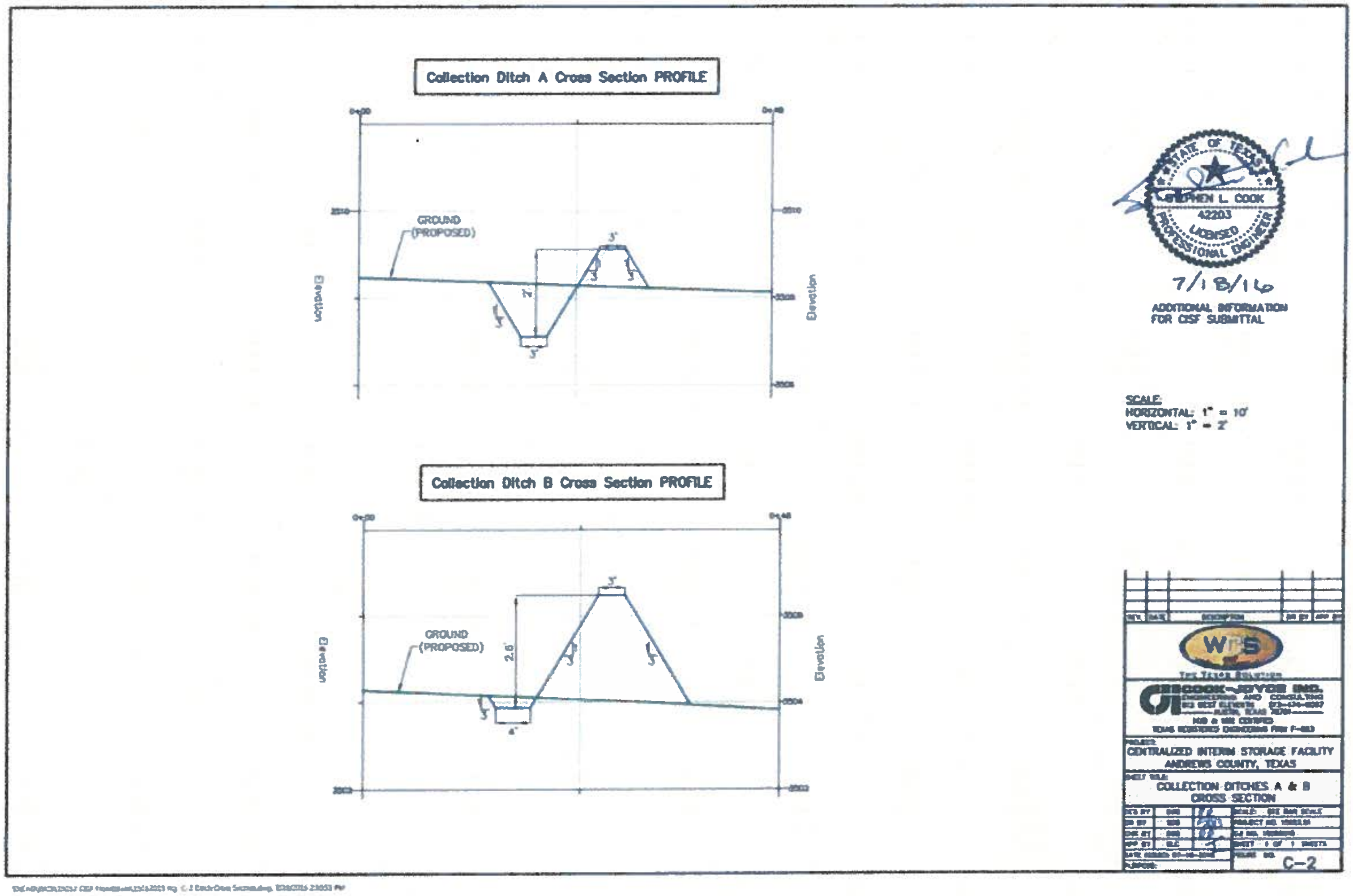


Figure 2-27 CJI C-2 Collection Ditches A &B Cross Section

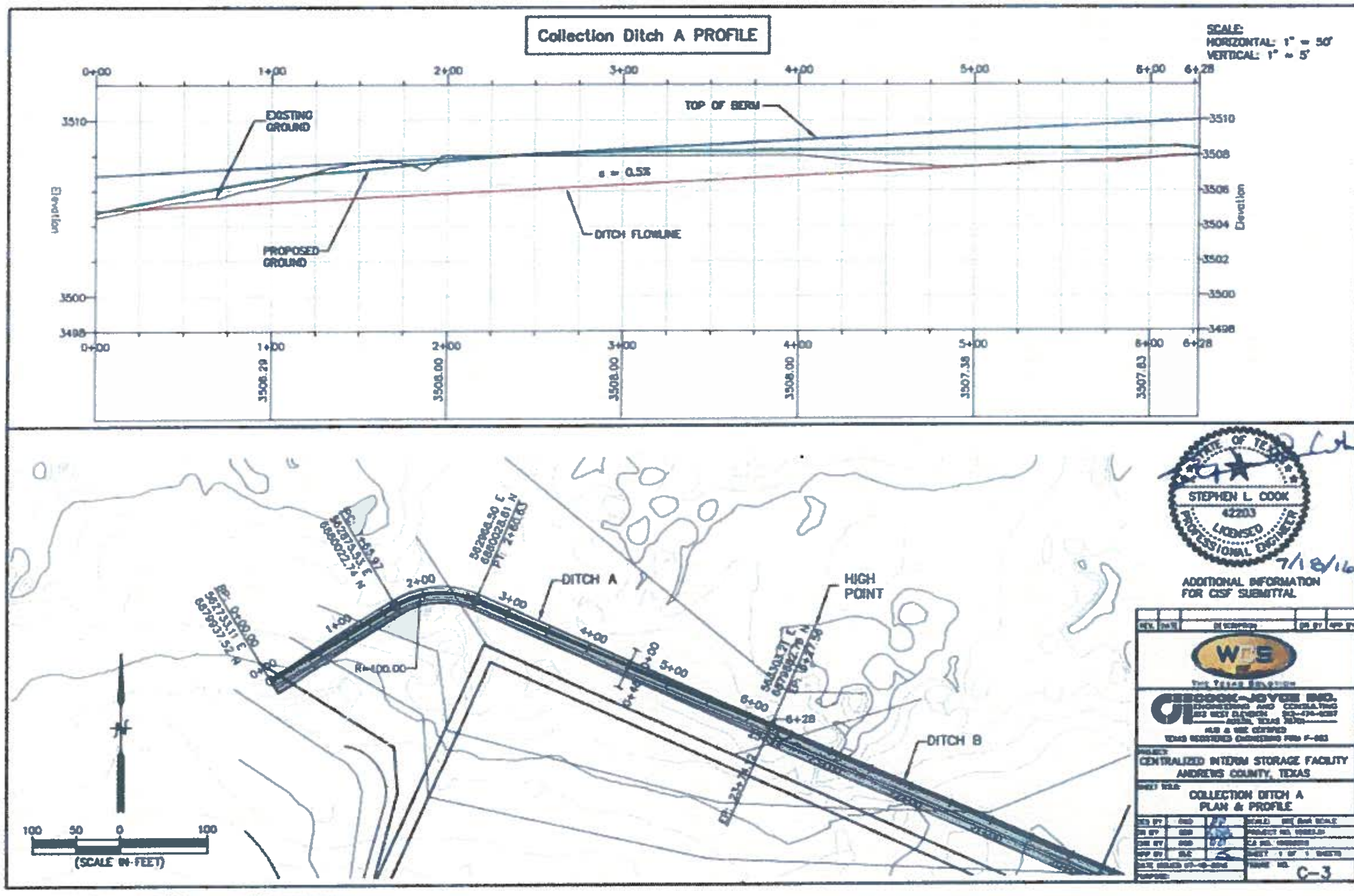


Figure 2-28 CJI C-3 Collection Ditch A Plan & Profile

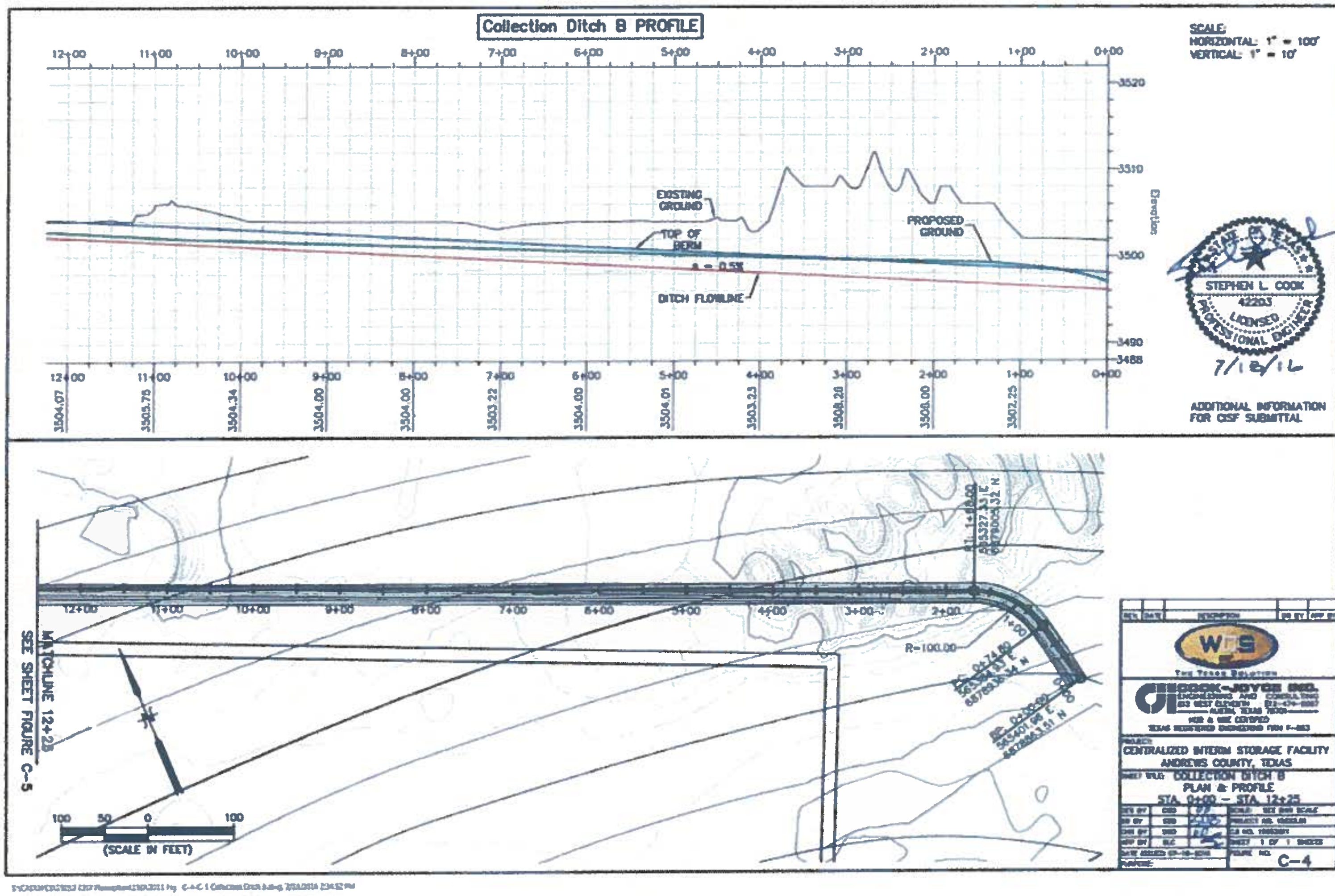


Figure 2-29 CJI C-4 Collection Ditch B Plan & Profile STA. 0+00 – STA. 12+25

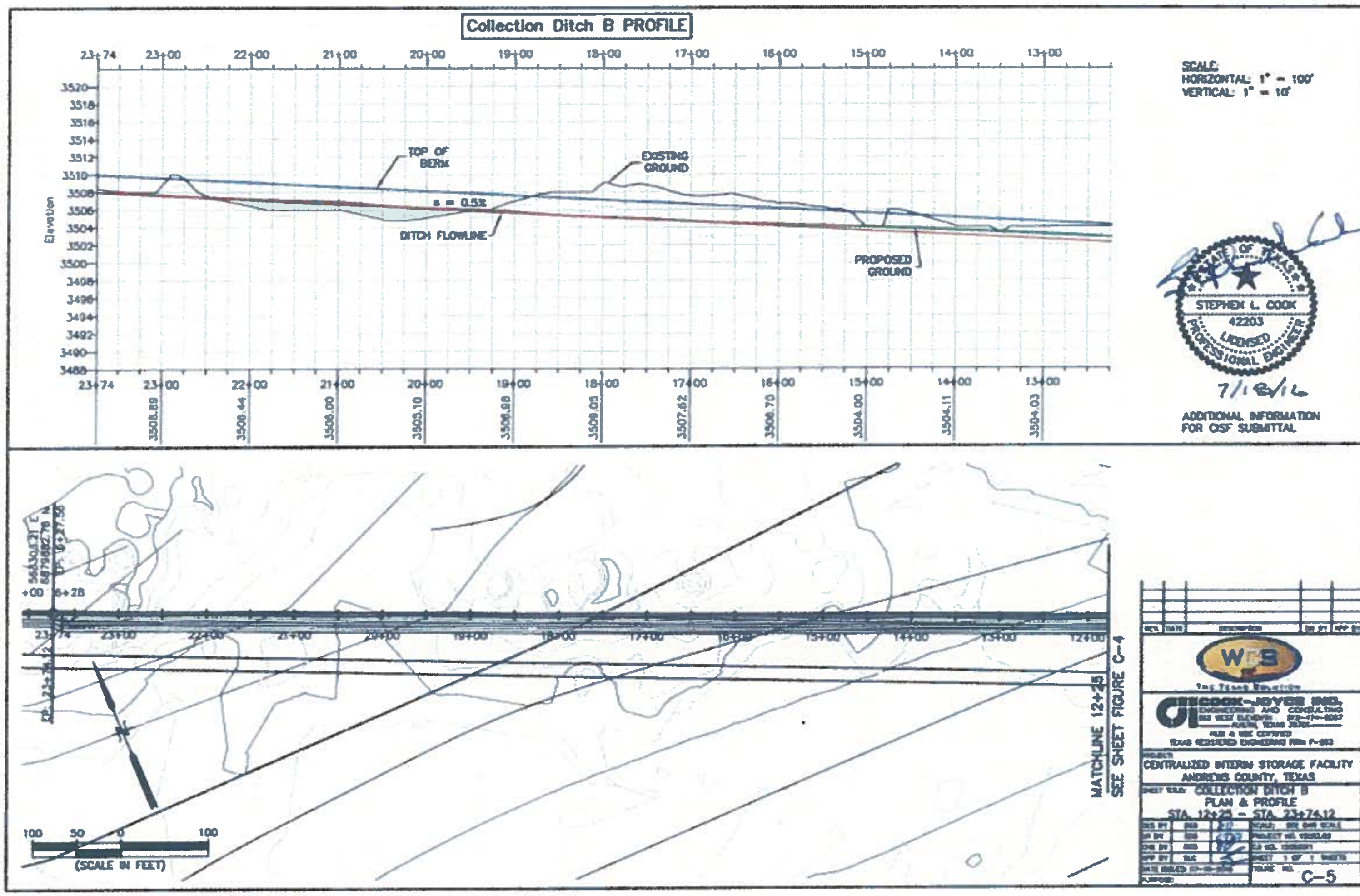


Figure 2-30 CJI C-5 Collection Ditch B Plan & Profile STA. 12+25 – STA 23+74.12

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

<u>RSI NP-7.2</u>

Provide a calculation package for the analysis that supports the SAR Chapter 9 radiation protection evaluations and includes sample input and output files.

The calculation package should include information and analyses that support the evaluations described in Chapter 9 of the SAR. It should include such items as the basis for the increase in HSM surface dose rates and the amount of increase chosen, the use of non fuel hardware multiplication factors for MAGNASTOR surface currents, information demonstrating how the analysis considered the UMS and MPC systems (including surface currents for both systems), how the systems and site were modeled, and calculations for demonstrating compliance with 10 CFR Part 20 limits (including for individuals on site that are not radiation workers, such as the 2 mrem in an hour limit in 10 CFR 20.1301 (a)(2)).

This information is needed to determine compliance with 10 CFR 72.104, 10 CFR 72.106, 10 CFR 72.126 and 10 CFR 20.1101, 10 CFR 20.1201, and 10 CFR 20.1301.

<u>WCS Response to RSI 7.2:</u>

The following calculations are provided in response to this RSI:

- AREVA Calculation WCS01-0503, Site Dose Calculation for NUHOMS Component at WCS (SAR), Revision 0. (Input/output data supplied on enclosed disc)

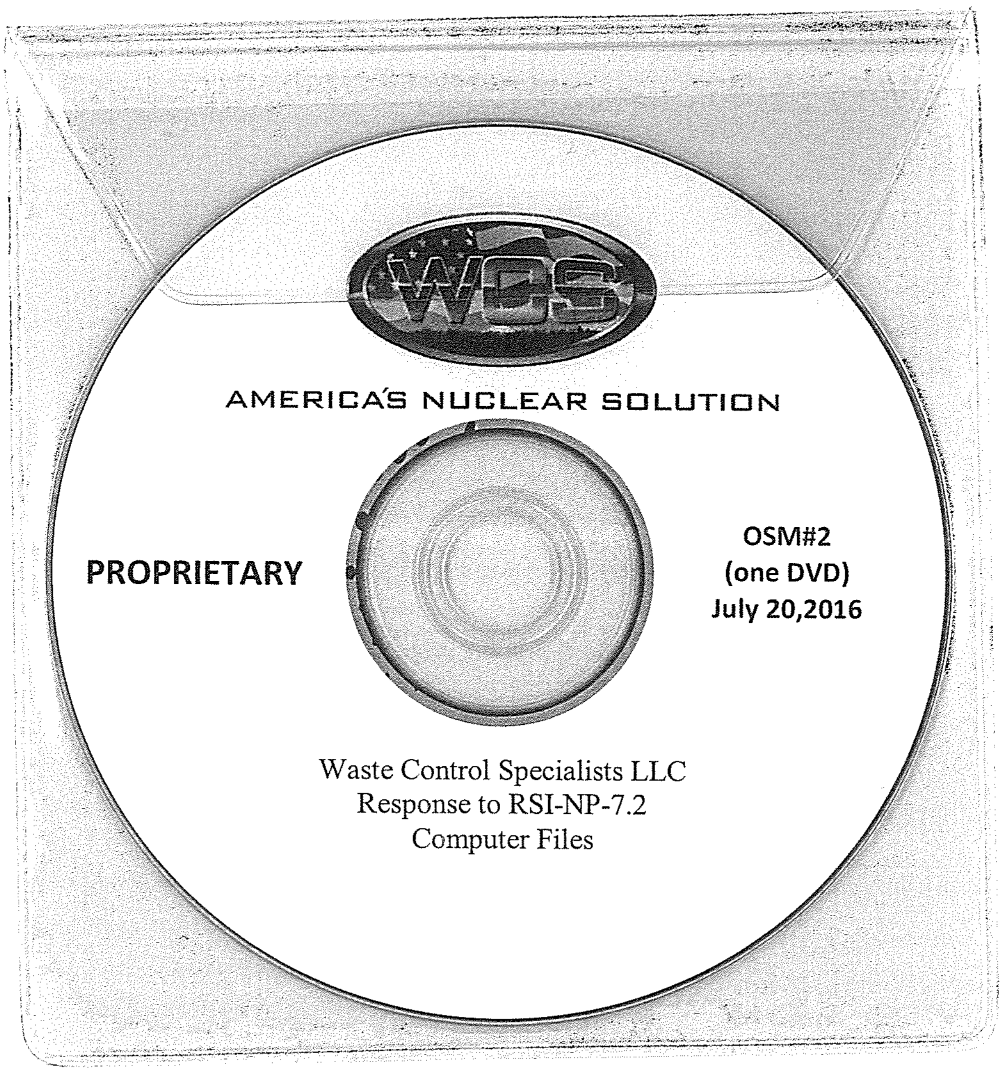
- NAC International Calculation, “WCS ISFSI Phase I Site Dose Rate Evaluation.” 30039-5001 Revision 0 (Input/output data supplied on enclosed disc)

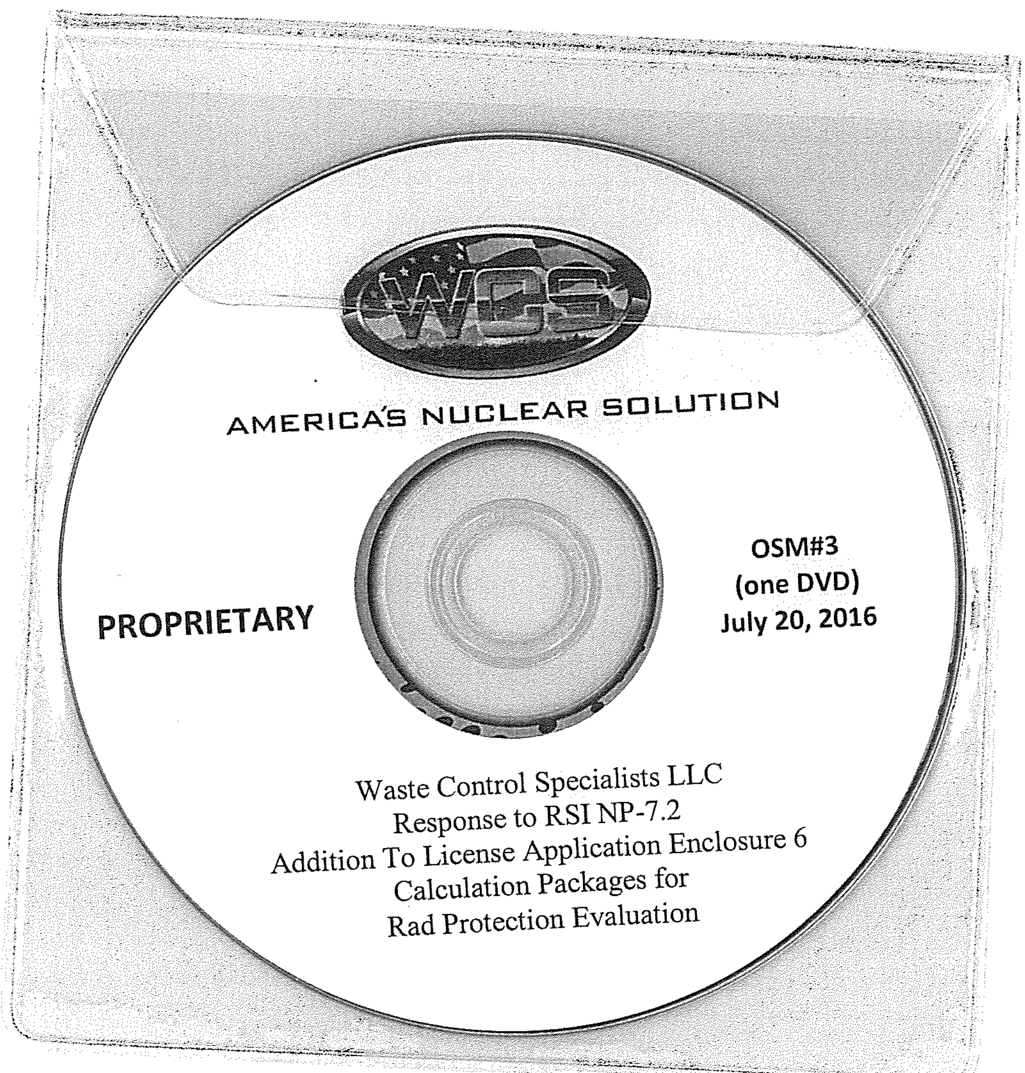
- AREVA Calculation WCS01-0505, WCS ISFSI Dose due to Combined Contribution from NUHOMS and NAC Storage Systems (SAR) after Loading Phase I, Revision 0. This calculation combines the results of AREVA Calculation WCS01-0503 and NAC International Calculation.

<u>WCS CISF Application Impact:</u>

Three calculations packages for Radiation Protection Evaluation are provided on enclosed disc and are to be added to Enclosure 6 (Disc 2, Calculations).

Computer files are provided on enclosed disc (Disc 3, Computer Files).


WCS
AMERICA'S NUCLEAR SOLUTION
PROPRIETARY
OSM#2
(one DVD)
July 20,2016
Waste Control Specialists LLC
Response to RSI-NP-7.2
Computer Files


WCS
AMERICA'S NUCLEAR SOLUTION
PROPRIETARY
OSM#3
(one DVD)
July 20, 2016
Waste Control Specialists LLC
Response to RSI NP-7.2
Addition To License Application Enclosure 6
Calculation Packages for
Rad Protection Evaluation

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-8.2:

Identify the correct revision of Amendment 0-3 for NAC MAGNASTOR in Enclosure 9 to the WCS CISF Application.

Revision 0 of Amendments 0, 1, 2, and 3 to the NAC MAGNASTOR CoC No. 1031 have been superseded by Revision 1 to these amendments. Revision 1 to the amendments need to be examined for compatibility with the site parameters, and if compatible, it should be referenced instead of Revision 0.

This information is needed to determine compliance with 10 CFR 72.18 and 10 CFR 72.24.

WCS response to RSI 8.2:

The table in Enclosure 9 listing Adams Accession numbers for the MAGNASTOR Storage System has been revised to eliminate reference to Revision 0 for Amendments 0-3 of CoC No.72-1031.

Although there have been many MAGNASTOR systems loaded to Revision 0 of Amendments 2 and 3, Revision 0 for those amendments will expire at the end of August 2016. Sites will be required to re-certify and re-register the MAGNASTOR storage systems to meet Revision 1 of Amendment 0-3 or a later Amendment as Revision 0 expires.

Revision 1 to the amendments have been reviewed for compatibility with WCS site parameters. None of these changes in Revision 1 are related to site parameters. Thus, they are compatible and are now referenced instead of Revision 0.

WCS Enclosure 9 Impact:

The table referencing the Adams Accession Numbers for MAGNASTOR in Enclosure 9 has been revised to delete reference to Revision 0 for Amendments 0 through 3. New table is provided.

ADAMS Accession Numbers Table
NAC International Inc.,

MAGNASTOR CoC Number - 72-1031				
Amendment Number	**CoC ML Number**	**SER ML Number**	**Tech Spec Appendix A ML Number**	**Tech Spec Appendix B ML Number**
5	ML15180A368	ML15180A381	ML15180A374	ML15180A379
4	ML15107A473	ML15107A472	ML15107A475	ML15107A474
3, Rev1~~3, Rev1~~	ML16029A155~~ML16029A155~~	ML16029A178~~ML16029A178~~	ML16029A160~~ML16029A160~~	ML16029A170~~ML16029A170~~
2, Rev1~~3~~	ML16029A194~~ML13207A350~~	ML16029A237~~ML13207A352~~	ML16029A207~~ML13150A388~~	ML16029A215~~ML13120A264~~
2, Rev1~~2, Rev1~~	ML16029A194~~ML16029A194~~	ML16029A237~~ML16029A237~~	ML16029A207~~ML16029A207~~	ML16029A215~~ML16029A215~~
0, Rev1~~2~~	ML16029A321~~ML120320242~~	ML16029A331~~ML120320247~~	ML16029A324~~ML12144A084~~	ML16029A329~~ML12144A102~~
1, Rev1~~1, Rev1~~	ML16029A245~~ML16029A245~~	ML16029A265~~ML16029A265~~	ML16029A256~~ML16029A256~~	ML16029A260~~ML16029A260~~
2, Rev1~~1~~	ML16029A194~~ML102910125~~	ML16029A237~~ML102910134~~	ML16029A207~~ML102910141~~	ML16029A215~~ML102910149~~

Electronic or hardcopies were found for all, with the exception of NAC-MPC, Tech Spec, Appendix B, A0 and A1
X – No ML Number Available on NRC website

ADAMS Accession Numbers Table
NAC International Inc.,

~~0, Rev1~~	~~ML16029A321~~	~~ML16029A331~~	~~ML16029A324~~	~~ML16029A329~~
0, Rev1~~0~~	ML16029A321~~ML090350554~~	ML16029A331~~ML090350589~~	ML16029A324~~ML090350566~~	ML16029A329~~ML090350580~~

Electronic or hardcopies were found for all, with the exception of NAC-MPC, Tech Spec, Appendix B, A0 and A1
X – No ML Number Available on NRC website

ADAMS Accession Numbers Tables

NAC International Inc.,

NAC-UMS CoC Number - 72-1015				
Amendment Number	**CoC ML Number**	**SER ML Number**	**Tech Spec Appendix A ML Number**	**Tech Spec Appendix B ML Number**
5	ML090120439	ML090120477	ML090120459	ML09120473
4	X (Filed with ML052860167)	ML052860175	ML052860167	X (Filed with ML052860167)
3	ML040830062	ML040830070	ML040830052	ML040830054
2	ML020250588	ML020250602	ML020250599	ML020250599
1	ML010260194	ML010400311	ML010260245	ML010260245
0	ML003743491	ML003743531	ML003743508	ML003743508

Electronic or hardcopies were found for all, with the exception of NAC-MPC, Tech Spec, Appendix B, A0 and A1
X – No ML Number Available on NRC website

ADAMS Accession Numbers Tables

NAC International Inc.,

NAC-MPC CoC Number - 72-1025				
Amendment Number	**CoC ML Number**	**SER ML Number**	**Tech Spec Appendix A ML Number**	**Tech Spec Appendix B ML Number**
6	ML102920651	ML102980010	ML102980018	ML102980019
5	ML072700048	ML072700066	ML072700057	ML072700057
4	ML043020232	ML043020555	ML043020537	ML043020537
3	ML032820223	ML032820236	ML031340571	ML031340571
2	ML021420149	ML021420176	ML021420175	ML021420175
1	ML020250518	ML020250532	ML020250524	X N/A
0	ML003704081	X (Filed With ML003704081)	ML003704081	X N/A

Electronic or hardcopies were found for all, with the exception of NAC-MPC, Tech Spec, Appendix B, A0 and A1
X – No ML Number Available on NRC website

ADAMS Accession Numbers Table
NAC International Inc.,

MAGNASTOR CoC Number - 72-1031				
Amendment Number	**CoC ML Number**	**SER ML Number**	**Tech Spec Appendix A ML Number**	**Tech Spec Appendix B ML Number**
5	ML15180A368	ML15180A381	ML15180A374	ML15180A379
4	ML15107A473	ML15107A472	ML15107A475	ML15107A474
3, Rev1	ML16029A155	ML16029A178	ML16029A160	ML16029A170
2, Rev1	ML16029A194	ML16029A237	ML16029A207	ML16029A215
1, Rev1	ML16029A245	ML16029A265	ML16029A256	ML16029A260
0, Rev1	ML16029A321	ML16029A331	ML16029A324	ML16029A329

Electronic or hardcopies were found for all, with the exception of NAC-MPC, Tech Spec, Appendix B, A0 and A1
X – No ML Number Available on NRC website
0a 07-15-2016

Standardized Advanced NUHOMS® System CoC Number - 72-1029			
Amendment Number	**CoC ML Number**	**SER ML Number**	**Tech Spec Appendix A ML Number**
3	ML15054A469	ML15054A499	ML15054A513
2	N/A	N/A	N/A
1	ML051520118	ML051520145	ML051520131
0	ML030100440	ML030100459	ML030100472

Standardized NUHOMS® System (61BT and 61BTH Type 1) CoC Number - 72-1004

Amendment Number	CoC ML Number	SER ML Number	Tech Spec Appendix A ML Number
13	ML14153A576	ML14153A579	ML14153A578
12	NA	NA	NA
11	ML14010A489	ML14010A486	ML14010A488
10	ML092290204	ML092290329	(3)
9	ML071070582	ML07010584	ML050900104
8	ML053390312	ML053390318 ML053390332(2)	ML053390315
7	ML040640929	ML040640934	ML040640933
6	ML040120814	ML031980374(1) ML031980374	ML040120847
5	ML040150841	ML040150842	ML040160455
4	ML020640241	ML020640326	ML020640306
3	ML012600510	ML012600517	ML012620192

(1) Only the proposed and preliminary SERs were found in ADAMS. AREVA has a copy submitted with letter ML040120756

(2) There are two parts to the SER, an ML number is listed for each part.

(3) Technical Specification not found in ADAMS. AREVA TN has copies of the Technical Specifications.

Sacramento Municipal Utility District License Number - SNM-2510 (Rancho Seco)			
Amendment Number	**License ML Number**	**SER ML Number**	**Tech Spec Appendix A ML Number**
3	ML092240378	ML092240439	ML092240427
2	ML051100165	ML051100177	No Change
1	NA	NA	NA
0	ML003729742	ML003729758	ML003729742

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-8.3

Provide the licensing bases which ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety.

The WCS CISF SAR does not identify the cask design or the site features that ensure that a criticality is not caused by two unlikely, independent, and concurrent or sequential events. The SAR should include such a discussion, which should consider the likelihood of possible events (e.g., canister failure, flooding) over the 40-year license period.

This information is needed to determine compliance with 10 CFR 72.124(a).

WCS Response to RSI 8.3:

WCS has provided the requested information in section 10.1.2 of the WCS SAR.

WCS SAR Impact:

Changed to last sentence of third paragraph, WCS SAR Chapter 10, Section 10.1.2:

In addition, the maximum postulated flood at the WCS CISF is 1.1~~7~~ inches as documented in Section 2.4.2.2. ~~Therefore, there is no possibility of water ingress into the canisters.~~

Added to end of section WCS SAR Chapter 10, Section 10.1.2:

Under 10 CFR 72.124 storage systems must be designed to be maintained subcritical and to ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The two unlikely events for the WCS site are canister breach and severe flooding. Even under the maximum postulated flood the maximum amount of standing water on the pad would be 1.1 inches at the lowest point which would result from a maximum 72 hour rain fall of 40.5 inches. (See WCS SAR Chapter 2 Attachment B, Section 2.2.2 for precipitation amounts and see WCS SAR Chapter 2 Attachment B, Section 5.0 for the maximum depth of standing water). At the WCS CISF there are no other sources of standing water. Thus, the amount of standing water is insufficient to cause a criticality event.

Package confinement systems are likewise protected from damage. Canister cavity confinement features provide a defense-in-depth criticality control function by precluding the risk that any hydrogenous neutron moderator will be introduced into the SNF basket cavity of any package received for storage. Canister confinement features are summarized in Chapter 11. All of the canisters and associated storage overpacks have been evaluated for a 50-foot flood. The evaluations demonstrate that there is no breach of the confinement boundary (well beyond water tight) as discussed in Chapters 11, A.11, B.11, C.11, D.11, E.11, F.11 and G.11. In addition, the maximum postulated flood at the WCS CISF is 1.1 inches as documented in Section 2.4.2.2.

Under 10 CFR 72.124 storage systems must be designed to be maintained subcritical and to ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The two unlikely events for the WCS site are canister breach and severe flooding. Even under the maximum postulated flood, the maximum depth of standing water on the pad would be 1.1 inches at the lowest point. (See WCS SAR Chapter 2 Attachment B, Section 2.2.2 for precipitation amounts and see WCS SAR Chapter 2 Attachment B, Section 5.0 for the maximum depth of standing water). There are no other sources of standing water at the WCS CISF. Thus, the amount of standing water is insufficient to cause a criticality event.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-9.1:

Provide the Sections of the Technical Specifications that outline the requirements for preventing the leakage of radioactive materials and list the codes and standards for design, fabrication, and inspection of the:

- NUHOMS MP187 FO-, FC-, and FF- DSCs in Appendix A.11, "CONFINEMENT EVALUATION NUHOMS®-MP187 Cask System,"
- 24PT1 DSC in Appendix B.11.2, "Requirements for Normal Conditions of Storage," B.11.3, "Confinement Requirements for Hypothetical Accident Conditions,"
- 61 BT DSC in Appendix C.11.1, "Confinement Boundary," C.11.2, "Requirements for Normal Conditions of Storage," C.11.3, "Confinement Requirements for Hypothetical Accident Conditions,"
- 61 BTH Type 1 DSC in Appendix D.11.2, "Requirements for Normal Conditions of Storage," D.11.3, "Confinement Requirements for Hypothetical Accident Conditions,"
- NAC-MPCs in Appendix E.11, "CONFINEMENT EVALUATION NAC-MPC,"
- NAC-UMS TSCs in Appendix F.11, "CONFINEMENT EVALUATION NAC-UMS," and
- MAGNASTOR TSC in Appendix G.11, "CONFINEMENT EVALUATION NACMAGNASTOR," of the WCS SAR.

Although some of the appendices refer to the Technical Specifications in general and some do not, the specific sections of the Technical Specifications were not provided in the Chapter 11 appendices of the WCS SAR. Clarify which specific Technical Specifications are being referred to in the WCS SAR.

This information is needed to determine compliance with 10 CFR 72.24.

WCS Response to RSI 9.1:

WCS has provided the requested information in Appendix A – G of the WCS SAR. See attached Appendix mark-ups.

WCS SAR Impacts:

WCS has updated the following sections of Appendices A - G:

A.11.1, A.11.4
B.11.1, B.11.2, B.11.3, B.11.4
C.11.1, C.11.2, C.11.3, C.11.4
D.11.1, D.11.2, D.11.3, D.11.4
E.11, E.11.3
F.11, F.11.2
G.11, G.11.2

SAR Mark ups are below:

A.11.1 Confinement Boundary

The confinement boundary for the FO-, FC- and FF-DSCs is documented in Section 3.3.2.1 of [A.11-1].

The canisters will not release radioactive contents under all normal, off-normal, and accident conditions; see Section 3.3.2 and Section 8.2.2 of [A.11-1]. However, during fabrication and closure operations the confinement boundary was leak tested to 10^{-5} std cm^3/sec in accordance with ANSI N14.5 [A.11-2]. Therefore, for these canister designs, a non-mechanistic release is postulated based on a leakage rate of 10^{-5} std cm^3/sec.

Section 4.3, Codes and Standards, of the Technical Specifications for the Rancho Seco ISFSI [A.11-11] cites the applicable ASME Code for the MP187 FO-, FC-, and FF-DSCs.

Section 3.1, "DSC Integrity," of the Technical Specifications for the Rancho Seco ISFSI [A.11-11] includes limiting condition for operation (LCO) 3.1.1 for DSC vacuum pressure, LCO 3.1.2 for DSC helium leakage rate, and LCO 3.1.3 for DSC helium backfill pressure. These LCOs create a dry, inert, leak tight atmosphere which contributes to preventing the leakage of radioactive material.

A.11.4 References

A.11-1 "Rancho Seco Independent Spent Fuel Storage Installation, Final Safety Analysis Report, Volume 1, ISFSI System," NRC Docket No. 72-11, Revision 4.

A.11-2 ANSI N14.5, "Leakage Tests on Packages for Shipment of Radioactive Materials," 1997.

A.11-3 NRC Spent Fuel Project Office, Interim Staff Guidance, ISG-5, Rev. 1, "Confinement Evaluation."

A.11-4 NUREG-1536, Revision 1, "Standard Review Plan for Spent Fuel Dry Cask Storage Systems at a General License Facility," U.S. 200 Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

A.11-5 NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," Revision 0, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, March 2000.

A.11-6 Calvert Cliffs Nuclear Power Plant Calculation CA07718, "2011 Update of ISFSI USAR DSC Leakage Dose Analysis," NRC Ascension Number ML11364A025.

A.11-7 NUREG/CR-6672, Sandia National Laboratories, "Reexamination of Spent Fuel Shipment Risk Estimates," Volume 1, NRC Ascension Number ML003698324.

A.11-8 U.S. NRC Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982.

A.11-9 Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," EPA-520/1-88-020, September 1988.

A.11-10 Federal Guidance Report No. 12, "External Exposure to Radionuclides in Air, Water, and Soil," EPA 402-R-93-081, September 1993.

A.11-11 "Technical Specifications for the Rancho Seco Independent Spent Fuel Storage Installation," Amendment 3, USNRC Docket Number 72-0011.

Mark-up based on response to NRC RSI 9.1

B.11.1 Confinement Boundary

The 24PT1 DSC confinement is documented in Chapter 7 of the “Standardized Advanced NUHOMS® System Updated Final Safety Analysis Report” [B.11-1]. Section 7.1 of [B.11-1] details the requirements of the confinement boundary. ~~Section 4.3 of the Technical Specifications [B.11-2] lists the codes and standards for design, fabrication, and inspection of the 24PT1 DSC.~~

The Technical Specifications for Standardized Advanced NUHOMS® [B.11-2] outline the requirements for preventing the leakage of radioactive materials in the 24PT1 DSC. Section 4.3, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 24PT1 DSC, including alternatives to the ASME Code for the 24PT1 DSC shell assembly and basket.

Section 3.1, "DSC Integrity," of the Technical Specifications for the Standardized Advanced NUHOMS® [B.11-2] includes limiting condition for operation (LCO) 3.1.1.a for DSC vacuum drying time and pressure and LCO 3.1.2.a for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

Mark-up based on response to NRC RSI 9.1

B.11.2 Requirements for Normal Conditions of Storage

Section 7.2 of [B.11-1] describes how the 24PT1 DSC is designed, fabricated and tested to be "leaktight" to prevent the leakage of radioactive materials.

The Technical Specifications for Standardized Advanced NUHOMS® [B.11-2] outline the requirements for preventing the leakage of radioactive materials in the 24PT1 DSC. Section 4.3, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 24PT1 DSC, including alternatives to the ASME Code for the 24PT1 DSC shell assembly and basket.

Section 3.1, "DSC Integrity," of the Technical Specifications for the Standardized Advanced NUHOMS® [B.11-2] includes limiting condition for operation (LCO) 3.1.1.a for DSC vacuum drying time and pressure and LCO 3.1.2.a for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

Mark-up based on response to NRC RSI 9.1

B.11.3 Confinement Requirements for Hypothetical Accident Conditions

Section 7.3 of [B.11-1] provides a discussion on how the 24PT1 DSC is designed, fabricated and tested to be "leaktight" to prevent the leakage of radioactive materials following hypothetical accident conditions.

The Technical Specifications for Standardized Advanced NUHOMS® [B.11-2] outline the requirements for preventing the leakage of radioactive materials in the 24PT1 DSC. Section 4.3, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 24PT1 DSC, including alternatives to the ASME Code for the 24PT1 DSC shell assembly and basket.

Section 3.1, "DSC Integrity," of the Technical Specifications for the Standardized Advanced NUHOMS® [B.11-2] includes limiting condition for operation (LCO) 3.1.1.a for DSC vacuum drying time and pressure and LCO 3.1.2.a for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

Mark-up based on response to NRC RSI 9.1

B.11.4 References

B.11-1 AREVA TN Document, ANUH-01.0150, Revision 6, "Updated Final Safety Analysis Report for the Standardized Advanced NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," NRC Docket No. 72-1029.

B.11-2 AREVA TN, "Technical Specifications for the Standardized Advanced NUHOMS® System Operating Controls and Limits," USNRC Docket Number 72-1029.

Amendment 3,

C.11.1 Confinement Boundary

The NUHOMS®-61BT DSC confinement is documented in Appendix K Chapter 7 of the "Standardized NUHOMS® System Updated Final Safety Analysis Report" [C.11-1]. Section K.7.1 of reference [C.11-1] details the requirements of the confinement boundary.

The Technical Specifications for Standardized NUHOMS® [C.11-2] outline the requirements for preventing the leakage of radioactive materials in the 61BT-DSC. Section 4.2, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 61BT DSC, including alternatives to the ASME Code for the 61BT DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [C.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

C.11.2 Requirements for Normal Conditions of Storage

Section K.7.2 of reference [C.11-1] describes how the 61BT-DSC is designed and tested to be "leaktight" to prevent the leakage of radioactive materials. The Technical Specification for Standardized NUHOMS® [C.11-2] outlines the requirements for preventing the leakage of radioactive materials in the 61BT-DSC.

Section 4.2, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 61BT DSC, including alternatives to the ASME Code for the 61BT DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [C.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

C.11.3 Confinement Requirements for Hypothetical Accident Conditions

Section K.7.3 of reference [C.11-1] provides a discussion on how the Standardized NUHOMS® - 61BT DSC is designed and tested to be "leaktight" to prevent the leakage of radioactive materials following hypothetical accident conditions. The Technical Specification for Standardized NUHOMS® [C.11-2] outlines the requirements for preventing the leakage of radioactive materials following hypothetical accident conditions in the 61BT-DSC.

Section 4.2, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 61BT DSC, including alternatives to the ASME Code for the 61BT DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [C.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

Mark-up based on response to NRC RSI 9.1

C.11.4 References

C.11-1 AREVA TN Document NUH-003, Revision 14, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel." (Basis for NRC CoC 72-1004).

C.11-2 AREVA TN, "Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System," USNRC Docket Number 72-1004.

Amendment 13,

Mark-up based on response to NRC RSI 9.1

D.11.1 Confinement Boundary

The 61BTH Type 1 DSC confinement is documented in Appendix T Chapter 7 of the "Standardized NUHOMS® System Updated Final Safety Analysis Report" [D.11-1]. Section T.7.1 of [D.11-1] details the requirements of the confinement boundary. ~~Section 1.1.12.4 of the Technical Specifications [D.11-2] lists the codes and standards for design, fabrication, and inspection of the 61BTH Type 1 DSC~~.

The Technical Specifications for Standardized NUHOMS® [D.11-2] outline the requirements for preventing the leakage of radioactive materials in the 61BTH Type 1 DSC. Section 4.2, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 61BTH (Type 1 and Type 2) DSC, including alternatives to the ASME Code for the 61BTH (Type 1 and Type 2) DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [D.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

D.11.2 Requirements for Normal Conditions of Storage

Section T.7.2 of [D.11-1] describes how the 61BTH Type 1 DSC is designed, fabricated and tested to be "leaktight" to prevent the leakage of radioactive materials. The Technical Specifications for Standardized NUHOMS® [D.11-2] outlines the requirements for preventing the leakage of radioactive materials in the 61BTH Type 1 DSC.

Section 4.2, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 61BTH (Type 1 and Type 2) DSC, including alternatives to the ASME Code for the 61BTH (Type 1 and Type 2) DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [D.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

Mark-up based on response to NRC RSI 9.1

D.11.3 Confinement Requirements for Hypothetical Accident Conditions

Section T.7.3 of [D.11-1] provides a discussion on how the 61BTH Type 1 DSC is designed, fabricated and tested to be "leaktight" to prevent the leakage of radioactive materials following hypothetical accident conditions. The Technical Specification for Standardized NUHOMS® [D.11-2] outlines the requirements for preventing the leakage of radioactive materials following hypothetical accident conditions in the 61BTH Type 1 DSC.

Section 4.2, "Codes and Standards," lists the codes and standards for design, fabrication, and inspection of the 61BTH (Type 1 and Type 2) DSC, including alternatives to the ASME Code for the 61BTH (Type 1 and Type 2) DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [D.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

Mark-up based on response to NRC RSI 9.1

D.11.4 References

D.11-1 AREVA TN Document NUH-003, Revision 14, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel." (Basis for NRC CoC 72-1004).

D.11-2 AREVA TN Americas, "Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System", USNRC Docket Number 72-1004.

Amendment 13,

E.11 CONFINEMENT EVALUATION

The NAC-MPC storage system is provided in three configurations. The Yankee-MPC provides storage for up to 36 intact Yankee Class spent fuel assemblies and reconfigured fuel assemblies (RFA). The CY-MPC holds up to 26 Connecticut Yankee spent fuel assemblies, reconfigured fuel assemblies or damaged fuel cans. The MPC-LACBWR provides storage for up to 68 Dairyland Power Cooperative La Crosse Boiling Water Reactor spent fuel assemblies with 32 damaged fuel cans. These three configurations of the NAC-MPC have similar components and operating features, but have different physical dimensions, weights and storage capacities. Confinement features for the Yankee-MPC and CY-MPC systems are addressed in the main body of Chapter 7 of Reference E.11-1. Appendix 7.A of Reference E.11-1 has been added to address the MPC-LACBWR system.

The codes and standards for the design, fabrication, and inspection of the canister and confinement boundary are detailed in Reference E.11-2. Specifically, Appendix B, Section B 3.3, "Codes and Standards", which states the ASME Boiler and Pressure Vessel Code (ASME Code), 1995 Edition with Addenda through 1995, is the governing Code for the NAC-MPC System canister except that Addenda through 1997 are applied for critical flaw evaluation of the canister closure weld and Section B 3.3.1, "Alternatives to the ASME Code", which lists the Code alternatives for the canister in Table B3-1. Included in this table is the leaktight criterion of ANSI N14.5 for the canister.

Appendix A, Section A 3.1, "NAC-MPC System Integrity", of Reference E.11.2, includes limiting condition for operation (LCO) 3.1.1 for canister maximum vacuum drying time, LCO 3.1.2 for canister vacuum drying pressure, and LCO 3.1.3 for canister helium backfill pressure. These LCOs create a dry, inert, leak-tight atmosphere which contributes to preventing the leakage of radioactive material.

E.11.3 References

E.11-1 NAC-MPC Final Safety Analysis Report, Revision 10, January 2014

E.11-2 Amendment No. 6 to Certificate of Compliance No. 1025 for the NAC International, Inc., NAC-MPC Multi-Purpose Canister System, October 4, 2010

F.11 CONFINEMENT EVALUATION

The NAC-UMS storage system is provided in two configurations, PWR – 3 different lengths and BWR – 2 different lengths. The NAC-UMS provides storage for up to 24 PWR spent fuel assemblies or up to 56 BWR spent fuel assemblies. These configurations of the NAC-UMS have similar components and operating features, but have different physical dimensions, weights and storage capacities.

Confinement features for the NAC-UMS system are addressed in the main body of Chapter 7 of the NAC-UMS FSAR, Reference F.11.2-1.

The codes and standards for the design, fabrication, and inspection of the canister and confinement boundary are detailed in Reference F.11-2. Specifically, Appendix B, Section B 3.3, "Codes and Standards", which states the ASME Code, 1995 Edition with Addenda through 1995, is the governing Code for the NAC-UMS canister and Section B 3.3.1, "Exceptions to Codes, Standards, and Criteria", which lists the Code exceptions for the canister in Table B3-1. Included in this table is the leaktight criterion of ANSI N14.5 for the canister.

Appendix A, Section A 3.1, "NAC-UMS System Integrity", of Reference F.11.2, includes limiting condition for operation (LCO) 3.1.1 for canister maximum vacuum drying time, LCO 3.1.2 for canister vacuum drying pressure, and LCO 3.1.3 for canister helium backfill pressure. These LCOs create a dry, inert, leak-tight atmosphere which contributes to preventing the leakage of radioactive material.

F.11.2 References

F11.2-1 NAC-UMS Universal Storage System Final Safety Analysis Report, Revision 10, October 2012.

F11.2-2 Amendment No. 5 to Certificate of Compliance No. 1015 for the NAC International, Inc., NAC-UMS Universal Storage System, January 12, 2008.

there should be a period after the "F"

G.11 CONFINEMENT EVALUATION

The MAGNASTOR TSC provides confinement for its radioactive contents in long-term storage. The confinement boundary provided by the TSC is closed by welding, creating a solid barrier to the release of contents in the design basis normal conditions and off-normal or accident events. The welds are visually inspected and nondestructively examined to verify integrity.

The sealed TSC contains a pressurized inert gas (helium). The confinement boundary retains the helium and also prevents the entry of outside air into the TSC in long-term storage. The exclusion of air precludes fuel rod cladding oxidation failures during storage.

The TSC confinement system meets the requirements of 10 CFR 72.24 for protection of the public from release of radioactive material. The design of the TSC allows the recovery of stored spent fuel should it become necessary per the requirements of 10 CFR 72.122. The TSC meets the requirements of 10 CFR 72.122 (h) for protection of the spent fuel contents in long-term storage such that future handling of the contents would not pose an operational safety concern.

The codes and standards for the design, fabrication, and inspection of the canister and confinement boundary are detailed in Reference G.11-2. Specifically, Appendix A, Section 4.2, "Codes and Standards", which states the ASME Code, 2001 Edition with Addenda through 2003, Section III, Subsection NB, is the governing Code for the design, material procurement, fabrication, and testing of the canister and Section 4.2.1, "Alternatives to Codes, Standard, and Criteria", which lists the approved alternatives to the ASME Code in Table 2.1-2 in the NAC-MAGNASTOR Final Safety Analysis Report (FSAR). In addition, Section 4.1.4, "TSC Confinement Integrity", which states the leaktight criterion for the canister is ANSI N14.5.

Appendix A, Section 3.1, "MAGNASTOR System Integrity", of Reference G.11.2, includes limiting condition for operation (LCO) 3.1.1 for canister maximum vacuum drying time, canister vacuum drying pressure, and canister helium backfill density. These LCOs create a dry, inert, leak-tight atmosphere which contributes to preventing the leakage of radioactive material.

G.11.2 References

G.11-1 MAGNASTOR Final Safety Analysis Report, Revision 7, July 2015

G.11-2 Amendment No. 5 to Certificate of Compliance No. 1031 for the NAC International, Inc., NAC-MAGNASTOR System, June 29, 2015

A.11.1 Confinement Boundary

The confinement boundary for the FO-, FC- and FF-DSCs is documented in Section 3.3.2.1 of [A.11-1].

The canisters will not release radioactive contents under all normal, off-normal, and accident conditions; see Section 3.3.2 and Section 8.2.2 of [A.11-1]. However, during fabrication and closure operations the confinement boundary was leak tested to 10^{-5} std cm^3/sec in accordance with ANSI N14.5 [A.11-2]. Therefore, for these canister designs, a non-mechanistic release is postulated based on a leakage rate of 10^{-5} std cm^3/sec.

Section 4.3, Codes and Standards, of the Technical Specifications for the Rancho Seco ISFSI [A.11-11] cites the applicable ASME Code for the MP187 FO, FC-, and FF-DSCs.

Section 3.1, “DSC Integrity”, of the Technical Specifications for the Rancho Seco ISFSI ; [A.11-11] includes limiting condition for operation (LCO) 3.1.1 for DSC vacuum pressure, LCO 3.1.2 for DSC helium leakage rate, and LC 3.1.3 for DSC helium backfill pressure. These LCOs create dry, inert, leak tight atmosphere, which contributes to preventing the leakage of radioactive material.

A.11.4 References

A.11-1 "Rancho Seco Independent Spent Fuel Storage Installation, Final Safety Analysis Report, Volume 1, ISFSI System," NRC Docket No. 72-11, Revision 4.

A.11-2 ANSI N14.5, "Leakage Tests on Packages for Shipment of Radioactive Materials," 1997.

A.11-3 NRC Spent Fuel Project Office, Interim Staff Guidance, ISG-5, Rev. 1, "Confinement Evaluation."

A.11-4 NUREG-1536, Revision 1, "Standard Review Plan for Spent Fuel Dry Cask Storage Systems at a General License Facility," U.S. 200 Regulatory Commission, Office of Nuclear Material Safety and Safeguards.

A.11-5 NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," Revision 0, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, March 2000.

A.11-6 Calvert Cliffs Nuclear Power Plant Calculation CA07718, "2011 Update of ISFSI USAR DSC Leakage Dose Analysis," NRC Ascension Number ML11364A025.

A.11-7 NUREG/CR-6672, Sandia National Laboratories, "Reexamination of Spent Fuel Shipment Risk Estimates," Volume 1, NRC Ascension Number ML003698324.

A.11-8 U.S. NRC Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982.

A.11-9 Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," EPA-520/1-88-020, September 1988.

A.11-10 Federal Guidance Report No. 12, "External Exposure to Radionuclides in Air, Water, and Soil," EPA 402-R-93-081, September 1993.

A.11-11 "Technical Specifications for the Rancho Seco Independent Spent Fuel Installation, Amendment 3, USNRC Docket Number 72-0011.

B.11.1 Confinement Boundary

The 24PT1 DSC confinement is documented in Chapter 7 of the "Standardized Advanced NUHOMS® System Updated Final Safety Analysis Report" [B.11-1]. Section 7.1 of [B.11-1] details the requirements of the confinement boundary. The Technical Specifications for Standardized Advanced NUHOMS® [B.11-2] outline the requirements for preventing the leakage of radioactive materials in the 24PT1 DSC. Section 4.3, "Codes and Standards", lists the codes and standards for design, fabrication, and inspection of the 24PT1 DSC, including alternatives to the ASME Code for the 24PT1 DSC shell assembly and basket.

Section 3.1, "DSC Integrity", of the Technical Specifications for the Standardized Advanced NUHOMS® [B.11-2] includes limiting condition for operations (LCO) 3.1.1.a for DSC vacuum drying time and pressure and LCO 3.1.2.a for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere, which contributes to preventing the leakage of radioactive material

.

B.11.2 Requirements for Normal Conditions of Storage

Section 7.2 of [B.11-1] describes how the 24PT1 DSC is designed, fabricated and tested to be “leaktight” to prevent the leakage of radioactive materials. The Technical Specifications for Standardized Advanced NUHOMS® [B.11-2] outline the requirements for preventing the leakage of radioactive materials in the 24PT1 DSC. Section 4.3, “Codes and Standards”, lists the codes and standards for design, fabrication, and inspection of the 24PT1 DSC, including alternatives to the ASME Code for the 24PT1 DSC shell assembly and basket.

Section 3.1, “DSC Integrity”, of the Technical Specifications for the Standardized Advanced NUHOMS® [B.11-2] includes limiting condition for operations (LCO) 3.1.1.a for DSC vacuum drying time and pressure and LCO 3.1.2.a for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere, which contributes to preventing the leakage of radioactive material

B.11.3 Confinement Requirements for Hypothetical Accident Conditions

Section 7.3 of [B.11-1] provides a discussion on how the 24PT1 DSC is designed, fabricated and tested to be "leak tight" to prevent the leakage of radioactive materials following hypothetical accident conditions. The Technical Specifications for Standardized Advanced NUHOMS® [B.11-2] outline the requirements for preventing the leakage of radioactive materials in the 24PT1 DSC. Section 4.3, "Codes and Standards", lists the codes and standards for design, fabrication, and inspection of the 24PT1 DSC, including alternatives to the ASME Code for the 24PT1 DSC shell assembly and basket.

Section 3.1, "DSC Integrity", of the Technical Specifications for the Standardized NUHOMS® [B.11-2] includes limiting condition for operation (LCO) 3.1.1.a for DSC vacuum drying time and pressure and LCO 3.1.2.a for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere, which contributes to preventing the leakage of radioactive material.

B.11.4 References

B.11-1 AREVA TN Document, ANUH-01.0150, Revision 6, "Updated Final Safety Analysis Report for the Standardized Advanced NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," NRC Docket No. 72-1029.

B.11-2 AREVA TN, "Technical Specifications for the Standardized Advanced NUHOMS® System Operating Controls and Limits," Amendment 3, USNRC Docket Number 72-1029.

C.11.1 Confinement Boundary

The NUHOMS®-61BT DSC confinement is documented in Appendix K Chapter 7 of the "Standardized NUHOMS® System Updated Final Safety Analysis Report" [C.11-1]. Section K.7.1 of reference [C.11-1] details the requirements of the confinement boundary. The Technical Specifications for Standards NUHOMS® [C.11-2] outline the requirements for preventing the leakage of radioactive materials in the 61BT-DSC. Section 4.2, "Codes and Standards", lists the codes and standards for design, fabrication, and inspection of the 61BT DSC, including alternatives to the ASME Code for the 61BT DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity", of the Technical Specifications for the Standardized NUHOMS® [C.11-2] includes limiting conditions for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

C.11.2 Requirements for Normal Conditions of Storage

Section K.7.2 of reference [C.11-1] describes how the 61BT-DSC is designed and tested to be “leaktight” to prevent the leakage of radioactive materials. The Technical Specification for Standardized NUHOMS® [C.11-2] outlines the requirements for preventing the leakage of radioactive materials in the 61BT-DSC. Section 4.2, “Codes and Standards, “lists the codes and standards for design, fabrication and inspection of the 61BT DSC, including alternatives to the ASME Code for the 61BT DSC confinement boundary and basket.

Section 3.1, “Fuel Integrity”, of the Technical Specifications for the Standardized NUHOMS® [C.11-2] includes limiting conditions for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

C.11.3 Confinement Requirements for Hypothetical Accident Conditions

Section K.7.3 of reference [C.11-1] provides a discussion on how the Standardized NUHOMS® - 61BT DSC is designed and tested to be "leaktight" to prevent the leakage of radioactive materials following hypothetical accident conditions. The Technical Specification for Standardized NUHOMS® [C.11-2] outlines the requirements for preventing the leakage of radioactive materials following hypothetical accident conditions in the 61BT-DSC. Section 4.2, "Codes and Standards, "lists the codes and standards for design, fabrication and inspection of the 61BT DSC, including alternatives to the ASME Code for the 61BT DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity", of the Technical Specifications for the Standardized NUHOMS® [C.11-2] includes limiting conditions for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere which contributes to preventing the leakage of radioactive material.

C.11.4 References

C.11-1 AREVA TN Document NUH-003, Revision 14, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel." (Basis for NRC CoC 72-1004).

C.11-2 AREVA TN, "Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System," Amendment 13,USNRC Docket Number 72-1004.

D.11.1 Confinement Boundary

The 61BTH Type 1 DSC confinement is documented in Appendix T Chapter 7 of the "Standardized NUHOMS® System Updated Final Safety Analysis Report" [D.11-1]. Section T.7.1 of [D.11-1] details the requirements of the confinement boundary. The Technical Specifications for Standardized NUHOMS® [D.11-2] outline the requirements for preventing the leakage of radioactive materials in the 61BTH Type 1 DSC. Section 4.2, "Codes and Standards", lists the codes and standards for design, fabrication, and inspection of the 61BTH (Type 1 and Type 2) DSC, including alternatives to the ASME Code for the 61BTH (Type1 and Type 2) DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity", of the Technical Specifications for the Standardized NUHOMS® [D.11-2] includes limiting condition for operations (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying pressure and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere, which contributes to preventing the leakage of radioactive material.

D.11.2 Requirements for Normal Conditions of Storage

Section T.7.2 of [D.11-1] describes how the 61BTH Type 1 DSC is designed, fabricated and tested to be "leaktight" to prevent the leakage of radioactive materials. The Technical Specifications for Standardized NUHOMS® [D.11-2] outlines the requirements for preventing the leakage of radioactive materials in the 61BTH Type 1 DSC. Section 4.2, "Codes and Standards", lists the codes and standards for design, fabrication, and inspection of the 61BTH (Type 1 and Type 2) DSC, including alternatives to the ASME Code for the 61BTH (Type 1 and Type 2) DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [D.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere, which contributes to preventing the leakage of radioactive material.

D.11.3 Confinement Requirements for Hypothetical Accident Conditions

Section T.7.3 of [D.11-1] provides a discussion on how the 61BTH Type 1 DSC is designed, fabricated and tested to be "leaktight" to prevent the leakage of radioactive materials following hypothetical accident conditions. The Technical Specification for Standardized NUHOMS® [D.11-2] outlines the requirements for preventing the leakage of radioactive materials following hypothetical accident conditions in the 61BTH Type 1 DSC. Section 4.2, "Codes and Standards", lists the codes and standards for design, fabrication, and inspection of the 61BTH (Type 1 and Type 2) DSC, including alternatives to the ASME Code for the 61BTH (Type 1 and Type 2) DSC confinement boundary and basket.

Section 3.1, "Fuel Integrity," of the Technical Specifications for the Standardized NUHOMS® [D.11-2] includes limiting condition for operation (LCO) 3.1.1 for DSC bulkwater removal medium and vacuum drying and LCO 3.1.2 for DSC helium backfill pressure. These LCOs create a dry, inert atmosphere, which contributes to preventing the leakage of radioactive material

D.11.4 References

D.11-1 AREVA TN Document NUH-003, Revision 14, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel." (Basis for NRC CoC 72-1004).

D.11-2 AREVA TN Americas, "Technical Specifications for the Standardized NUHOMS® Horizontal Modular Storage System", Amendment 13, USNRC Docket Number 72-1004.

E.11 CONFINEMENT EVALUATION

The NAC-MPC storage system is provided in three configurations. The Yankee-MPC provides storage for up to 36 intact Yankee Class spent fuel assemblies and reconfigured fuel assemblies (RFA). The CY-MPC holds up to 26 Connecticut Yankee spent fuel assemblies, reconfigured fuel assemblies or damaged fuel cans. The MPC-LACBWR provides storage for up to 68 Dairyland Power Cooperative La Crosse Boiling Water Reactor spent fuel assemblies with 32 damaged fuel cans. These three configurations of the NAC-MPC have similar components and operating features, but have different physical dimensions, weights and storage capacities. Confinement features for the Yankee-MPC and CY-MPC systems are addressed in the main body of Chapter 7 of Reference E.11-1. Appendix 7.A of Reference E.11-1 has been added to address the MPC-LACBWR system.

The codes and standards for the design, fabrication, and inspection of the canister and confinement boundary are detailed in Reference E.11-2. Specifically, Appendix B, Section B.3.3, “Codes and Standards”, which states the ASME Boiler and Pressure Vessel Code (ASME Code), 1995 Edition with Addenda through 1995, is the governing Code for the NAC-MPC System canister except that Addenda through 1997, are applied for critical flaw evaluation of the canister closure weld and Section B.3.3.1, “Alternatives to the ASME Code”, which lists the Code alternatives for the canister in Table B3-1. Included in this table is the leaktight criterion of ANSI N14.5 for the canister.

Appendix A, Section A 3.1, “NAC-MPC System Integrity”, of Reference E.11.2, includes limiting condition for operation (LCO) 3.1.1 for canister maximum vacuum drying time, LCO 3.1.2 for canister vacuum drying pressure, and LCO 3.1.3 for canister helium backfill pressure. These LCOs create a dry, inert, leaktight atmosphere, which contributes to preventing the leakage of radioactive material.

E.11.3 References

E.11-1 NAC-MPC Final Safety Analysis Report, Revision 10, January 2014

E.11-2 Amendment No. 6 to Certificate of Compliance No. 1025 for the NAC International, INC., NAC-MPC Multi-Purpose Canister System, October 4, 2010

F.11 CONFINEMENT EVALUATION

The NAC-UMS storage system is provided in two configurations, PWR – 3 different lengths and BWR – 2 different lengths. The NAC-UMS provides storage for up to 24 PWR spent fuel assemblies or up to 56 BWR spent fuel assemblies. These configurations of the NAC-UMS have similar components and operating features, but have different physical dimensions, weights and storage capacities.

Confinement features for the NAC-UMS system are addressed in the main body of Chapter 7 of the NAC-UMS FSAR, Reference F.11.2-1.

The codes and standards for the design, fabrication, and inspection of the canister and confinement boundary are detailed in Reference F.11-2. Specifically, Appendix B, Section B 3.3, "Codes and Standards", which states the ASME Code, 1995 Edition with Addenda through 1995, is the governing Code for the NAC-UMS canister and Section B 3.3.1, "Exception to Codes, Standards, and Criteria" , which lists the Code exception for the canister in Table B3-1. Included in this table is the leaktight criterion of ANSI N14.5 for the canister.

Appendix A, Section A 3.1, "NAC-UMS System Integrity", of Reference F.11.2, includes limiting condition for operations (LCO) 3.1.1 for canister maximum vacuum drying time, LCO 3.1.2 fir canister vacuum drying pressure, and LCO 3.1.3 for canister helium backfill pressure. These LCOs create a dry, inert, leaktight atmosphere, which contributes to preventing the leakage of radioactive material.

F.11.2 References

F.11.2-1 NAC-UMS Universal Storage System Final Safety Analysis Report, Revision 10, October 2012.

F.11.2-2 Amendment No. 5 to Certificate of Compliance No. 1015 for the NAC International, Inc., NAC-UMS Universal Storage System, January 12, 2008.

G.11 CONFINEMENT EVALUATION

The MAGNASTOR TSC provides confinement for its radioactive contents in long-term storage. The confinement boundary provided by the TSC is closed by welding, creating a solid barrier to the release of contents in the design basis normal conditions and off-normal or accident events. The welds are visually inspected and nondestructively examined to verify integrity.

The sealed TSC contains a pressurized inert gas (helium). The confinement boundary retains the helium and also prevents the entry of outside air into the TSC in long-term storage. The exclusion of air precludes fuel rod cladding oxidation failures during storage.

The TSC confinement system meets the requirements of 10 CFR 72.24 for protection of the public from release of radioactive material. The design of the TSC allows the recovery of stored spent fuel should it become necessary per the requirements of 10 CFR 72.122. The TSC meets the requirements of 10 CFR 72.122 (h) for protection of the spent fuel contents in long-term storage such that future handling of the contents would not pose an operational safety concern.

The codes and standards for the design, fabrication, and inspection of the canister and confinement boundary are detailed in Reference G.11-2. Specifically, Appendix A, Section 4.2, “Codes and Standards”, which states the ASME code, 2001 Edition with Addenda through 2003, Section III, Subsection NB, is the governing Code for the design, material procurement, fabrication, and testing of the canister and Section 4.2.1, “Alternatives to Codes, Standard, and Criteria”, which lists the approved alternatives to the ASME Code in Table 2.1-2 in the NAC MAGNASTOR Final Safety Analysis Report (FSAR). In addition, Section 4.1.4, “TSC Confinement Integrity”, which states the leaktight criterion for the canister in ANSI N14.5.

Appendix A, Section 3.1, “MAGNASTOR System Integrity”, of Reference G.11.2, includes limiting condition for operation (LCO) 3.1.1 for canister maximum vacuum drying time, canister vacuum drying pressure, and canister helium backfill density. These LCOs create a dry, inert, leaktight atmosphere which contributes to preventing the leakage of radioactive material.

G.11.2 References

G.11-1 MAGNASTOR Final Safety Analysis Report, Revision 7, July 2015

G.11-2 Amendment No.5 to Certificate of Compliance No. 1031 for the NAC International, Inc., NAC-MAGNASTOR System, June 29,2015

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-9.5:

Provide site monitoring systems that measure radionuclides released under normal and accident conditions in Section 11.2, "Confinement Monitoring," of the WCS SAR, and other sections of the WCS SAR as appropriate. The site monitoring systems should address: 1) transportation package unloading of canister contents and 2) storage conditions.
See Sections 9.4.3, "Confinement Monitoring," 9.4.3.2, "Effluents," 9.5.3, "Confinement Monitoring," and 9.5.3.2, "Pool or waste management facilities" of NUREG 1567. Section 11.2 of the WCS SAR does not address a system to measure radionuclides released to the environment under normal and accident conditions. This includes all areas where there is the potential for significant releases to the environment and may include storage casks and waste management facilities during transportation package unloading of canister contents and storage conditions.

This information is needed to determine compliance with 10 CFR 72.24, 10 CFR 72.104, 10 CFR 72.106, and 10 CFR 72.126.

WCS Response to RSI 9.5:

WCS is not applying for a license that permits the unloading of canisters contents.

The onsite air monitoring and surveys will be conducted within the WCS Radiation Safety Program. Routine surveys will be performed per WCS approved procedures for direct alpha/beta/gamma/neutron measurements and removable contamination swipes. The air samples and swipes will processed on WCS calibrated Canberra gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer Liquid Scintillation Counters, and WCS calibrated Ortec Gamma Spectroscopy counters or equivalent equipment.

WCS will employ stationary continuous air monitors that will be installed at the Cask Handling Building, as described in Regulatory Guide 3.48 Section 7.3.4. These monitors will be used to assess the potential release of airborne radioactivity in off-normal events.

Similarly, WCS will employ stationary Area Radiation Monitors (ARMs) at the Cask Handling Building, as described in Regulatory Guide 3.48 Section 7.3.4. These detectors will also be set to alarm at pre-established levels of direct radiation. The purpose of these alarms are intended to ensure that trained workers are warned to take the appropriate actions in the event that anticipated dose rates exceeding specified action level occur at the Cask Handling Building.

The types, capabilities, and parameters of fixed ARMs and continuous air monitors are described in the most recent editions of ANSI N13.1, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" and ANSI/ANS-HPSSC-6.8.1, "Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Reactors".

WCS SAR Section 9.3.5, has been revised as part of our response to the RSI NP-12.1.

WCS SAR Impact:

(See WCS SAR Section 9.3.5, that has been revised as part of our response to the RSI NP-12.1).

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

<u>RSI NP-9.6</u>

Provide in Chapter 11 of the WCS SAR, or other sections of the WCS SAR, how site specific criteria are met using general license facility criteria with respect to acceptable measures that minimize the potential for transport of radioactive materials to the environment through the aquifer due to the design and proposed operations at the ISF.

This information is necessary to make evaluation finding F9.4 in NUREG 1567, this type of finding is not in NUREG 1536. This information was not described in Chapter 11 of the WCS SAR.

This information is needed to determine compliance with 10 CFR 72.122(b).

<u>WCS Response to RSI 9.6:</u>

WCS has provided the requested information in Chapter 9, Section 9.6 of the WCS SAR.

<u>WCS SAR Impact:</u>

Added sub-section to WCS SAR, Chapter 9, Section 9.6.

<u>9.6.5 Features to Prevent Transport of Radioactive Material to the Environment</u>

The CISF plans to accept only welded canisters with confinement intact. WCS plans to confirm integrity of confinement upon receipt. The Radiological Environmental Monitoring Programs ensures the detection of potential contamination that may be present at the CISF.

The features of the WCS site make transport of radioactive materials through an aquifer not credible. The WCS site is located in the arid Permian Basin with little precipitation and the nearest aquifer is located at a depth of 800 to 1000 feet (243 to 305 meters) below ground surface. The WCS site is separated from that aquifer by the Dockum Formation, consisting of low permeability clays ($1X10^{-9}$ cm/s).

The first potential water bearing zone is a dry transmissive unit and does not provide a transport mechanism. Monitor wells near the proposed CISF are installed in the uppermost transmissive zone and have been dry since installation in 2005 or 2008.

The CISF is required to be designed to facilitate decontamination of structures and equipment, minimize the quantity of radioactive wastes and contaminated equipment, and facilitate the removal of radioactive wastes and contaminated materials at the time it is permanently decommissioned pursuant to 10 CFR 72.130, Criteria of Decommissioning.

WCS will perform periodic surveys per WCS approved procedures for direct alpha/beta/gamma/neutron measurements and removable contamination swipes. The swipes will be processed on WCS calibrated gas flow proportional gross alpha/beta counters, WCS calibrated Liquid Scintillation Counters, and calibrated Gamma Spectroscopy counters to provide an early indication of any radioactive material that may be present. Air and soil samples will be collected under the Radiological Environmental Monitoring Program and shipped to an offsite certified laboratory for analysis.

9.6.2.4 Environmental Monitoring

WCS will establish a Radiological Environmental Monitoring Program (REMP) that will demonstrate compliance with 10 CFR 72.104. Details of this program are described in Chapter 9, section 9.6.2.

In establishing the environmental monitoring program for spent fuel storage, WCS will build upon its current monitoring program for its existing facilities. This program will include the following monitoring parameters: perimeter dosimetry (Landauer Inlight® Environmental X9 (beta/X/gamma) or equivalent), soil, and air locations. This program will be implemented by the radiation safety department in accordance with written procedures.

9.6.3 Maximum Off-Site Annual Dose

The nearest residence in Lea County, New Mexico is approximately 4 miles from the WCS CISF at SPCS coordinate (541732.42, 6873002.59). At this distance, the computed total dose rate is 4.83E-14 mrem/hr. With continuous occupancy of 8,760 hours per year, the total dose is 4.23E-10 mrem, which is essentially zero and less than the dose from natural background radiation.

9.6.4 Liquid Releases

As described in Section 6.1.2.1, there are no radioactive liquid radioactive wastes to monitor for the WCS CISF.

9.6.5 Features to Prevent Transport of Radioactive Material to the Environment

The CISF plans to accept only welded canisters with confinement intact. WCS plans to confirm integrity of confinement upon receipt. The Radiological Environmental Monitoring Program ensure the detection of potential contamination that may be present at the CISF.

The features of the WCS site make transport of radioactive materials through an aquifer not credible. The WCS site is located in the arid Permian Basin with little precipitation and the nearest aquifer is located at a depth of 800 to 1,000 feet (243 to 305, meters) below ground surface. The WCS site is separated from that aquifer by the Dockum Formation, consisting of low permeability clays ($1X10^{-9}$cm/s).

The first potential water bearing zone is a dry transmissive unit and does not provide a transport mechanism. Monitor wells near the proposed CISF are installed in the uppermost transmissive zone and have been dry since installation in 2005 or 2008.

The CISF is required to be designed to facilitate decontamination of structures and equipment, minimize the quantity of radioactive wastes and contaminated equipment, and facilitate the removal of radioactive wastes and contaminated materials at the time it is permanently decommissioned pursuant to 10 CFR 72.130, Criteria of Decommissioning.

WCS will perform periodic surveys per WCS approved procedures for direct alpha/beta/gamma/neutron measurements and removable contamination swipes. The swipes will be processed on WCS calibrated gas flow proportional gross alpha/beta counters, WCS calibrated Liquid Scintillation Counters, and calibrated Gamma Spectroscopy counters to provide an early indication of any radioactive material that may be present. Air and soil samples will be collected under the Radiological Environmental Monitoring Program and shipped to an offsite certified laboratory for analysis.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

<u>RSI NP-9.8</u>

Verify if a transportation package ensures confinement in Appendix A.11, or if the FO-, FC, and FF- DSCs ensure confinement.

Appendix A.11 is entitled, "CONFINEMENT EVALUATION NUHOMS®-MP187 Cask System," yet the MP187 is a transportation package. It should be clarified that the FO-, FC-, and FF-DSCs or canisters should be designed to ensure confinement.

This information is needed to determine compliance with 10 CFR 72.24, 10 CFR 72.104, and 10 CFR 72.106.

<u>WCS Response to RSI 9.8:</u>

The MP187 cask can be configured as either a transfer cask for transfer operations in accordance with 10 CFR Part 72 or a transportation cask in accordance with 10 CFR Part 71. Under the requested license for the WCS CISF, once the MP187 cask is received at the CISF site following transport, the cask will be reconfigured for transfer operations for which the canisters rather than the cask provide confinement.

<u>WCS SAR Impact:</u>

None.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI 10.2

Provide sufficient information in Section 4.6, "Transportation Cask Repair and Maintenance" of the CISF SAR to address shipping cask repair and maintenance as discussed in NUREG-1567 Section 3.4.7, "Shipping Cask Repair and Maintenance."

Section 4.6 of the CISF SAR indicates that repairs or maintenance of transportation packages may be done onsite (i.e., in situ). Thus, the SAR should describe the facilities and operation of the facilities to be used to conduct these repairs and maintenance activities. The description should include appropriate provisions for contamination control and minimization of occupational exposures. Further, the description should be clear that repairs and maintenance will be conducted in accordance with the maintenance program descriptions and requirements in the respective transportation packages' SARs' Chapter 8. The meaning of ‘another appropriate location' in the current CISF SAR text should also be clarified.

This information is needed to determine compliance with 10 CFR 72.128.

WCS Response to RSI 10.2:

WCS has revised CISF SAR Section 4.6 to state that the transport cask maintenance activities will be performed in the Cask Handling Building. In addition, WCS has added a new section, Section 4.6.1, “Transport Cask Maintenance Activities,” to the CISF SAR to describe the type of maintenance activities that will be performed on transportation casks and to describe the appropriate provisions for contamination control and minimization of occupational exposure.

WCS SAR Impact:

Added new Section 4.6.1 to the SAR, as discussed in the response.

4.6.1 Transport Cask Repair and Maintenance Activities

The following describes the types of repair and maintenance activities that will be performed at the Cask Handling Building on the transportation casks transporting canisters to the WCS CISF. Maintenance activities are limited primarily to those needed to support routine use of transportation casks. Those maintenance activities are required in the transportation certificates which reference Chapter 8 of the Transportation Cask SAR. The only expected radiological hazards would be from surface contamination on the outsides of the casks due to weeping from the cask surfaces that were exposed to contaminated fuel pool water. Prior to performing any maintenance activities, health physics personnel will survey the casks as required and incorporate the appropriate restrictions and controls to be observed during the planned maintenance activity.

The maintenance activities carried out at the Cask Handling Building include:

- Leak Tests
- Fastener Inspections and Replacement
- Impact Limiter Inspections
- Seal Areas and Groove Inspections
- Trunnion Inspections
- Rupture Disk and Gasket Inspections

Maintenance activities shall be conducted in accordance with the WCS Quality Assurance Program Description (QAPD). These maintenance activities are being performed at the WCS CISF facility, which is licensed under 10 CFR Part 72, A high level description of the types of maintenance activities listed above is provided below.

Leak Tests

When containment boundary seals are replaced, the seals are leak tested to show a leak rate less than the requirements listed in Chapter 8, Acceptance Tests and Maintenance Program of the applicable transportation cask SAR.

Fastener Inspections and Replacement

Vent/Test/Drain Port, impact limiter attachment, cask top closure plate, and ram closure plate fasteners, etc. are inspected for deformed or stripped threads. Damaged parts are documented with a non-conformance report and evaluated for continued use and replacement as required.

Impact Limiter Inspections

Visual examinations and inspections of the impact limiters, including any attachment mechanisms used are performed looking for damage or excessive wear. Damaged parts are documented with a non-conformance report and evaluated for continued use, replaced or repaired as required. In addition, the impact limiters are inspected to verify that a significant amount of water has not been absorbed and that degradation of the energy absorbing material has not occurred. These inspections are performed by weighing the impact limiter and visual examination of the impact limiters and welds. Evidence of weld cracking or other damage which could result in water in-leakage is documented and dispositioned with a non-conformance report.

Seal Areas and Groove Inspections

Sealing surfaces and O-ring grooves are inspected when the seals are replaced for damaging burrs or scratches or as otherwise required. Damaged parts are documented in a non-conformance report and evaluated for continued use or repair.

Trunnion Inspections

The trunnion and trunnion sockets are inspected for excessive wear, galling or distortion. Dimensional testing, visual inspection and nondestructive examination of accessible critical areas of the trunnions including the bearing surfaces are performed. A non-conformance is generated to document and disposition any excessive wear, galling or distortion that is observed.

Rupture Disk and Gasket Inspections

Some transport casks contain a neutron shield or other rupture disks which require visual inspection to verify no evidence of damage. Evidence of damage is documented in a non-conformance report for disposition.

4.6 Transportation Cask Repair and Maintenance

If visual inspections reveal the need for repairs or maintenance, these activities will be performed either in situ or in another appropriate location, based on the nature of the work to be performed. Radiation protection personnel will provide input and monitor these activities. Work will be performed under the NRC approved WCS CISF Quality Assurance Program Description [4-4] in accordance with written procedures that meet the transportation license requirements under 10 CFR Part 71.

4.6.1 Transport Cask Repair and Maintenance Activities

The following describes the types of repair and maintenance activities that will be performed at the Cask Handling Building on the transportation casks transporting canisters to the WCS CISF. Maintenance activities are limited primarily to those needed to support routine use of transportation casks. Those maintenance activities are required in the transportation certificates which reference Chapter 8 of the Transportation Cask SAR. The only expected radiological hazards would be from surface contamination on the outsides of the casks due to weeping from the cask surfaces that were exposed to contaminated fuel pool water. Prior to performing any maintenance activities, health physics personnel will survey the casks as required and incorporate the appropriate restrictions and controls to be observed during the planned maintenance activity.

The maintenance activities carried out at the Cask Handling Building include:

- Leak Tests
- Fastener Inspections and Replacement
- Impact Limiter Inspections
- Seal Areas and Groove Inspections
- Trunnion Inspections
- Rupture Disk and Gasket Inspections

Maintenance activities shall be conducted in accordance with the WCS Quality Assurance Program Description (QAPD). These maintenance activities are being performed at the WCS CISF facility, which is licensed under 10 CFR Part 72, A high level description of the types of maintenance activities listed above is provided below.

Leak Tests

When containment boundary seals are replaced, the seals are leak tested to show a leak rate less than the requirements listed in Chapter 8, Acceptance Tests and Maintenance Program of the applicable transportation cask SAR.

Fastener Inspections and Replacement

Vent/Test/Drain Port, impact limiter attachment, cask top closure plate, and ram closure plate fasteners, etc. are inspected for deformed or stripped threads. Damaged parts are documented with a non-conformance report and evaluated for continued use and replacement as required.

Impact Limiter Inspections

Visual examinations and inspections of the impact limiters, including any attachment mechanisms used are performed looking for damage or excessive wear. Damaged parts are documented with a non-conformance report and evaluated for continued use, replaced or repaired as required. In addition, the impact limiters are inspected to verify that a significant amount of water has not been absorbed and that degradation of the energy absorbing material has not occurred. These inspections are performed by weighing the impact limiter and visual examination of the impact limiters and welds. Evidence of weld cracking or other damage which could result in water in-leakage is documented and dispositioned with a non-conformance report.

Seal Areas and Groove Inspections

Sealing surfaces and O-ring grooves are inspected when the seals are replaced for damaging burrs or scratches or as otherwise required. Damaged parts are documented in a non-conformance report and evaluated for continued use or repair.

Trunnion Inspections

The trunnion and trunnion sockets are inspected for excessive wear, galling or distortion. Dimensional testing, visual inspection and nondestructive examination of accessible critical areas of the trunnions including the bearing surfaces are performed. A non-conformance is generated to document and disposition any excessive wear, galling or distortion that is observed.

Rupture Disk and Gasket Inspections

Some transport casks contain a neutron shield or other rupture disks which require visual inspection to verify no evidence of damage. Evidence of damage is documented in a non-conformance report for disposition.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-10.4

Provide sufficient information on the off normal holding area described in SAR Section 4.1.2.11 which states: *Any casks arriving on-site via rail car are visually inspected for any damage prior to entry into the Cask Handling Building. If damage is noted, the transportation cask will be assessed and the transportation cask will be held in the Cask Handling Building or on the rail spur within the OCA until a recovery plan is implemented.* Include a description of equipment procedures and monitoring systems for components important to safety that ensure radiological protection, shielding, confinement, monitoring effluents, and protection of the spent fuel cladding.

This information is needed to determine compliance with 10 CFR 72.122(h)(1), 10 CFR 72.126(a), 10 CFR 72.126(b), 10 CFR 72.126(c), and 10 CFR 72.128(a)

WCS Response to RSI 10.4:

WCS has provided the requested information by revising WCS SAR Chapter 4, Section 4.1.2.11 with changes below.

WCS SAR Impact:

Following changes to WCS SAR Chapter 4, Section 4.1.2.11.

4.1.2.11 Off-Normal Holding Area

~~Any casks arriving on-site via rail car are visually inspected for any damage prior to entry into the Cask Handling Building. If damage is noted, the transportation cask will be assessed and the transportation cask will be held in the Cask Handling Building or on the rail spur within the OCA until a recovery plan is implemented.~~

Transport casks arriving at the CISF via rail spur will be visually inspected and radiation dose rate and contamination surveys will be performed.

If initial radiological surveys preclude completion of the other steps of receipt inspection, WCS will isolate the rail car or move the rail car to the Cask Handling Building and establish appropriate radiological controls. WCS will document the damage, notify the NRC of the condition and develop a corrective action plan. WCS will evaluate the use of movable shielding to protect personnel from radiation exposure while the damaged cask is on site.

If initial radiological surveys do not prevent further receipt inspection, WCS will move the transportation cask to the Cask Handling Building. WCS will assess the safety features of the transport cask including seal leak testing and cask sipping analysis for indications that the canister integrity is intact. If WCS concludes that the transportation cask is capable of performing its intended safety functions, WCS will proceed with the receipt as per established procedure.

If the assessment indicates that the transport cask integrity is not intact, WCS will ensure the cask continues to be isolated, document the damage, notify the NRC of the condition and develop a corrective action plan. WCS will establish measures to ensure control of contamination and maintain doses ALARA.

WCS will utilize swipes and air samples that will be processed on WCS calibrated Canberra® gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer® Liquid Scintillation Counters, and WCS calibrated Ortec® Gamma Spectroscopy counters or equivalent equipment. Sipping analysis will be performed on a calibrated gas chromatograph or equivalent equipment.

4.1.2.7 Rail Side Track

The rail side track will depart from the existing WCS rail loop and extend north and to the east into the PA and the Cask Handling Building. There is sufficient rail length for 10 rail cars to be inside the PA before indexing through the Cask Handling Building. Unloaded rail cars will exit the Cask Handling Building and continue east on the rail sidetrack which will connect back into the existing WCS rail loop.

4.1.2.8 Security and Administration Building

The Security and Administration Building will coordinate several functions for the WCS CISF. Security personnel will monitor sensors and intrusion alarms, control employee access, and process visitors into the WCS CISF. Health physics will operate and store equipment in this building and an administration staff will use this building for processing shipments and storing records. The building will contain the Central Alarm Station (CAS), Armory, locker rooms, break room, offices, health physics spaces, and records storage. The backup electrical generator system for the WCS CISF is located at this building.

4.1.2.9 Receiving Area

When the shipping cask arrives at the WCS CISF, the shipping cask and cradle are visually inspected for damage prior to entry into the OCA.

4.1.2.10 Concrete Cask Staging Area

There is an area inside the Cask Handling Building for VCC staging for VCCs awaiting loading via the Canister Transfer System. Additional staging areas are available outside the security boundaries of the WCS CISF.

4.1.2.11 Off-Normal Holding Area

Transport casks arriving at the CISF via rail spur will be visually inspected and radiation dose rate and contamination surveys will be performed.

If initial radiological surveys preclude completion of the other steps of receipt instruction, WCS will isolate the rail car or move the rail car to the Cask Handling Building and establish appropriate radiological controls. WCS will document the damage, notify the NRC of the condition and develop a corrective action plan. WCS will evaluation the use of movable shielding to protect personnel from radiation exposure while the damaged cask is on site.

If initial radiological surveys do not prevent further receipt inspection, WCS will move the transportation cask to the Cask Handling Building. WCS will assess the safety features of the transport cask including seal leak testing and cask sipping analysis for indications that the canister integrity is intact. If WCS concludes that the transportation cask is capable of performing its intended safety functions, WCS will proceed with the receipt as per established procedure.

If the assessment indicates that the transport cask integrity is not intact, WCS will ensure the cask continues to be isolated, document the damage, notify the NRC of the condition and develop a corrective action plan. WCS will establish measures to ensure control for contamination and maintain doses ALARA.

WCS will utilize swipes and air samples that will be processed on WCS calibrated Canberra® gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer® Liquid Scintillation Counters, and WCS calibrated Ortec® Gamma Spectroscopy counters or equivalent equipment. Sipping analysis will be performed on a calibrated gas chromatograph or equivalent equipment.

4.1.2.12 Water Utilities and Fire Protection

Potable water will be supplied to the WCS CISF from the existing WCS potable water system. The WCS CISF porable water system will tie-in to the existing potable water system at WCS. Fire protection will be maintained by WCS in accordance with National Fire Protection Association (NFPA) standards.

4.1.2.13 Site Utility Supplies and Systems

Existing WCS site electrical service exists at the WCS CISF location. This infrastructure will be upgraded to accommodate the WCS CISF needs.

4.1.2.14 Storage Tanks

Storage tanks are used in a limited capacity. The WCS CISF will have an above ground holding tanks at the Security and Administration Building and at the Cask Handling Building.

4.1.2.15 Stacks

There are no stacks at the WCS CISF.

4.1.2.16 Temporary Facilities

Additional security positions and receiving and inspection areas will be used and located as needed.

4.1.3 Control Room and Control Area

The WCS CISF is a passive installation, with no need for operator actions. No control room is needed for normal operations; however, the instrumentation used to monitor storage overpack temperatures have readouts in the Administration and Security Building.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

<u>RSI NP-12.1:</u>

Provide information to:

a. Address contamination control areas

b. Describe the types, capabilities and parameters of area radiation monitors and airborne monitoring instrumentation for the site

It is not clear that the SAR addresses this information. Guidance regarding these aspects of the facility is provided in NUREG-1567 Sections 11.4.2.2 and 11.4.2.5. The information should be included for the facility and areas in facility structures where spent fuel and GTCC waste containers are handled, transferred or stored (e.g., cask handling building) and other CISF structures as appropriate for ensuring compliance with dose limits for personnel, members of the public, and non-radiation worker personnel and individuals on site such as CISF administration and security staff and railroad personnel involved in the delivery to and shipment from the CISF of transport packages. The limits for members of the public apply to this third group of people (i.e., personnel and individuals that are not radiation workers) even while on site.

This information is needed to determine compliance with 10 CFR 72.24(e), 10 CFR 72.126 and 10 CFR 20.1301(b).

<u>WCS Response to RSI 12.1:</u>

a. <u>Contaminated Control Areas</u>

WCS has revised WCS SAR Section 9.3.2.1 to address contamination control areas.

Shipments shall be offloaded under the WCS Radiation Safety Program (RSP) and shall remain ALARA. Site workers will log into the site Radiological Work Permit covering the CISF Cask Handling Building. Shipments shall be under the control of qualified Radiation Safety Technicians. Shipments shall be surveyed for direct alpha/beta/gamma/neutron radiation and swipe samples shall be taken on the exterior of the conveyance prior to any offload activities. Based on the surveys, offloads will be handled in accordance with approved WCS procedures. Air monitoring shall be conducted by installing calibrated air samplers (i.e., Low Volume air sampling (0.5 – 4 cfm) or High Volume (4 – 10 cfm) air sampling as applicable) within the Cask Handling Building to be used for each offload. Routine continuous air monitoring will also be conducted within the Cask Handling Building using Low Volume air sampling equipment. Should contamination be detected on the transportation cask above site (Regulatory Guide 1.86) and DOT conveyance limits, proper notification shall be given to the applicable regulatory entities. Offload of contaminated containers will not proceed until contamination control measures have been put in place (e.g., tent offload area or other structure, air monitoring (area and personnel), ventilation (if required) and proper PPE for site personnel) to control contamination within the Cask Handling Building.

b. <u>Describe the types, capabilities and parameters of area radiation monitors and airborne monitoring instrumentation for the site</u>

The onsite air monitoring and surveys will be conducted within the WCS RSP. Routine surveys will be performed per WCS approved procedures for direct alpha/beta/gamma/neutron measurements and removable contamination swipes. The air samples and swipes will processed on WCS calibrated Canberra gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer Liquid Scintillation Counters, and WCS calibrated Ortec Gamma Spectroscopy counters or equivalent equipment.

WCS will employ stationary continuous air monitors that will be installed at the Cask Handling Building, as described in Regulatory Guide 3.48 Section 7.3.4. These monitors will be used to assess the potential release of airborne radioactivity in off-normal events.

Similarly, WCS will employ stationary Area Radiation Monitors (ARMs) at the Cask Handling Building, as described in Regulatory Guide 3.48 Section 7.3.4. These detectors will also be set to alarm at pre-established levels of direct radiation. The purpose of these alarms are intended to ensure that trained workers are warned and take the appropriate actions in the event that anticipated dose rates exceeding specified action level occur at the Cask Handling Building.

The types, capabilities, and parameters of fixed ARMs and continuous air monitors are described in the applicable editions of ANSI N13.1, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" and ANSI/ANS-HPSSC-6.8.1, "Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Reactors".

General Access Controls

CISF personnel including administration and security staff and railroad personnel involved in the delivery to and shipment from the CISF of transport packages will be trained in accordance with 10 CFR Part 19. These workers are considered "Radiation Workers" and the occupational radiation dose limits specified in 10 CFR Part 20 Subpart C. Individuals (visitors) that are not trained in accordance with 10 CFR Part 19 are considered members of the public and the dose limits specified 10 CFR Part 20.1301 apply.

Waste water will be collected in above ground holding tanks. The contents of the tanks will be sampled and analyzed prior to their disposal in an offsite Publically Owned Treatment Works (POTW). The concentrations of radioactivity that may be released to a POTW (sanitary sewage) are specified in Table 3, Releases to Sewers, of Appendix B of 10 CFR Part 20.

WCS limits the allowable level of radioactivity that may be present on items and equipment intended for unrestricted use based on Regulatory Guide 1.86.

Drawings of the facilities depicting personnel change rooms, including lavoratories, location of hand/foot monitors, continuous air monitors and area radiation monitors are depicted in Figure 9-4.

<u>WCS SAR Impact:</u>

Add to SAR section 9.3.2.1, page 9-9 below the first paragraph:

The CISF Protected Area boundary will be posted as a “restricted area, radioactive material area, dosimetry and RWP required for entry”. The CISF Cask Handling Building will be posted as a radiation area or high radiation area per 10 CFR Part 20 limits. Contaminated areas will be posted pursuant to the limits specified in Regulatory Guide 1.86.

WCS will establish access controls to ensure that unauthorized access to inside the Owner Controlled Area and the Protected Area does not occur. These controls will be established for radiation protection, security, and safeguards purposes. The site layout, including a description of barriers and gates that will be used to preclude ready access into the controlled areas of the CISF is provided in the Physical Security Plan.

<u>WCS SAR Section 9.3.5, page 9-10:</u>

9.3.5 Area Radiation and Airborne Radioactivity Monitoring System
Area Radiation monitoring will be via the WCS Radiation Safety Program. ~~As discussed in Section 4.5.3, no sampling is required for airborne radioactivity for the safe operation of the WCS CISF.~~ WCS will employ stationary continuous air monitors that will be installed at the Cask Handling Building, as described in Regulatory Guide 3.48 Section 7.3.4. These monitors will be used to assess the potential release of airborne radioactivity in off-normal events.

Similarly, WCS will employ stationary Area Radiation Monitors (ARMs) at the Cask Handling Building, as described in Regulatory Guide 3.48 Section 7.3.4.

The types, capabilities, and parameters of fixed ARMs and continuous air monitors are described in the applicable ANSI N13.1, “Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities” and ANSI/ANS-HPSSC-6.8.1, “Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Reactors”.

9.3 Radiation Protection Design Features

The radiation protection design features are discussed in this section.

9.3.1 Installation Design Features

Only canisterized SNF and GTCC waste is authorized for storage at the WCS CISF.

The Cask Handling Building houses the equipment used to handle the transition between transportation configurations under 10 CFR Part 71 to transfer operations under 10 CFR Part 72 for the canisters. The canisters are well shielded by the transportation casks and transfer casks during these operations. A thick steel plug is in place at the end of the canisters to minimize the dose rate at the cask top (and bottom for NUHOMS®) when the canisters are transferred from one overpack to another.

Table 9-4 provides the cross reference to the applicable appendix and section for each canister/storage overpack where the operational considerations for each system are discussed.

9.3.2 Access Control

The WCS CISF is located within the owner controlled area. A separate protected area consisting of a double fenced, double gated, lighted area is installed around the storage facility. Access to the protected area is controlled by locked gates, and guards will be stationed whenever the WCS CISF gates are open. Remote sensing devices are employed to detect unauthorized access to the facility.

9.3.2.1 Controlled Area

Within the Owner Controlled Area, a restricted area is established to control access to radiation areas in order to maintain worker exposures ALARA.

The CISF Protected Area boundary will be posted as “restricted area, radioactive material area, dosimetry and RWP required for entry”. The CISF Cask Handling Building will be posted as a radiation area or high radiation area per 10 CFR Part 20 limits. Contaminated areas will be posted pursuant to the limits specified in Regulatory Guide 1.86.

WCS will establish access controls to ensure that unauthorized access inside the Owner Controlled Area and the Protected Area. These controls will be established for radiation protection, security, and safeguards purposes. The site layout, including a description of barriers and gates that will be used to preclude ready access into the Owner Controlled Area of the CISF is provided in the Physical Security Plan.

9.3.3.3 Storage Area Shielding

The Table 9-4 provides the cross reference to the applicable appendix and section for each canister/storage overpack where the storage overpack shielding for each system is discussed.

9.3.4 Ventilation

Only NRC approved canisterized SNF and GTCC waste are acceptable for receipt and storage at the WCS CISF. Therefore, no safety related ventilation systems are required to support operations at the WCS CISF.

9.3.5 Area Radiation and Airborne Radioactivity Monitoring System

Area Radiation monitoring will be via the WCS Radiation Safety Program, WCS will employ stationary continuous air monitors that will be installed at the Cask Handling Building, as described in Regulatory Guide 3.48, Section 7.3.4. These monitors will be used to assess the potential release of airborne radioactivity in off-normal events.

Similarly, WCS will employ stationary Area Radiation Monitors (ARMs) at the Cask Handling Building, as described in Regulatory Guide 3.48, Section 7.3.4

The types, capabilities, and parameters of fixed ARMs and continuous air monitors are described in the applicable ANSI N13.1, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities" and ANSI/ANS-HPSSC-6.8.1, "Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Reactors".

9.3.5.1 Area Radiation Monitoring System

Section 4.3.10 describes the Radiation Monitoring Systems to be employed at the WCS CISF.

9.3.5.2 Radioactive Airborne Effluent Monitoring System

Since there is no significant possibility of radionuclide release from the canisters during transfer or storage operations, airborne effluent monitoring system is not required for the safe operation of the WCS CISF. However, during receipt and transfer operations, portable airborne monitoring systems may be used in accordance with the WCS Radiation Safety Program.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-12.2

Provide information regarding the health physics/radiation protection (HP) facilities that are to be shared with the existing low-level radioactive waste (LLRW) facilities at the WCS site.

The SAR states that some HP facilities will be shared with those for the existing LLRW facilities. The SAR should still include a description of these HP facilities, including equipment they contain and functions they serve, as appropriate. The information should be adequate to demonstrate that the facilities are appropriate and adequate for the purposes they are intended to serve for the CISF.

This information is needed to determine compliance with 10 CFR 20.1101.

WCS Response to RSI 12.2

There are two health physics/radiation protection (HP) shared facilities at the WCS site The Low Level Facility Counting Laboratory and Treatment Storage and Disposal Facility Counting Laboratory. These facilities are appropriate and adequate to serve the CISF because the instrumentation detects all radioisotopes that would be present at both the CISF and the existing facilities.

WCS maintains calibrated Canberra gas flow proportional gross alpha/beta counters, calibrated Perkin & Elmer Liquid Scintillation Counter, calibrated Ortec Gamma Spectroscopy counter, Canberra In-Situ Object Counting System (ISOCS), calibrated air monitoring equipment and various calibrated Ludlum hand held instruments (i.e., models 9-3, 12-4, 78, 2360, 2241, 19, and 3) or equivalent equipment. The onsite air monitoring and surveys will be conducted within the WCS Radiation Safety Program. The surveys will be performed per WCS approved procedures for direct alpha/beta/gamma/neutron measurements and removable contamination swipes. The air samples and swipes will be processed on WCS calibrated Canberra gas flow proportional gross alpha/beta counters, WCS calibrated Perkin & Elmer Liquid Scintillation Counters, and WCS calibrated Ortec Gamma Spectroscopy counters or equivalent equipment.

The facilities and equipment provide us the capabilities to assure compliance with 10 CFR 20.1101 for both low level waste facilities and the CISF.

WCS SAR Impact:

Changes to WCS SAR, Chapter 9, Section 9.5.2, page 9-14 and 9-15.

9.5.2 Equipment, Instrumentation and Facilities

Facility requirements to support the CISF radiation protection functions are as follows.

- Instrument calibration area ~~(exists as part of the existing LLW operations)~~
- Personnel change rooms, including lockers
- Access control stations for entrance to and exit from radiation areas and, if needed, temporary contamination control areas
- Office space to accommodate Radiation Protection staff

- Counting laboratory ~~(exists as part of the existing LLW operations).~~

9.5 Radiation Protection Program During Operation

The major radiation protection functions of the Radiation Protection program during operations of the Cask Handling Building are described in this section. The WCS CISF Radiation Protection program is planned and organized in accordance with the criteria of NRC Regulatory Guides 8.8 and 8.10, and NUREG-0761.

9.5.1 Organization and Functions

For occupational exposure control, radiation protection systems are provided to control personnel exposure to radiation. Administration of the Radiation Protection program is accomplished with a trained and qualified staff of Radiation Protection professionals. Tasks include radiation monitoring and communication to operations personnel.

Radiation survey information associated with transportation, transfer and storage of casks is provided. This information includes use of portable radiation monitoring equipment to measure direct gamma and neutron radiation levels in the vicinity of the casks. It also includes the measurement and control of radiation contamination. Permanent and temporary shielding is used to reduce exposure to personnel. Areas are surveyed for radiation, and job postings are provided to define the need for anti-contamination clothing, in order to reduce the potential for personnel contamination when accessing areas of potential contamination.

Radiological monitoring, sampling, maintenance and calibration are provided. General area monitoring equipment located in the shipping/receiving and transfer areas is sufficient for fixed monitoring requirements. Additionally, more detailed radiation surveys are provided by Radiation Protection personnel covering specific operations.

In the WCS CISF Radiation Protection organization, the Radiation Protection Supervisor reports to the Radiation Safety Officer without operating pressures. Sufficient Radiation Protection personnel are available to perform routine functions and to respond to anticipated occurrences and accident conditions in a timely manner. Contract services are identified in the organization, and may include instrument calibration, contamination smear counting, dosimetry counting and radiation protection training.

9.5.2 Equipment, Instrumentation and Facilities

Facility requirements to support the CISF radiation protection functions are as follows.

- Instrument calibration area
- Personnel change rooms, including lockers
- Access control stations for entrance to and exit from radiation areas and, if needed, temporary contamination control areas
- Office space to accommodate Radiation Protection staff

- Counting laboratory

Equipment and instrumentation provided to support radiation protection functions are as follows.

- A proportional counter for contamination smears to define surface contamination and the need for decontamination
- Hand and foot contamination monitors stationed at building exits to prevent the spread of contamination
- Portable monitoring equipment to augment fixed detector systems
- Personnel protective equipment and clothing
- Personnel dosimetry instrumentation and equipment, including the following.
  - Optically stimulated luminescence monitoring for permanent exposure records
  - Self-reading dosimeters for instantaneous readout and personnel exposure control
  - Computer hardware/software to record and analyze radiological monitoring/sampling and personnel exposure data.

9.5.3 Procedures

Radiation Protection activities are performed in accordance with procedures. Radiation Protection staff utilize procedures to perform the following.

- Take contamination swipes of potentially contaminated areas (transportation casks)
- Perform radiation surveys to define and maintain radiation dose rates in the radiation areas
- Post areas based on surveys
- Provide radiation work permits and perform pre-operational briefings
- Cover jobs to ensure radiation protection
- Evaluate personnel occupational radiation doses to determine if ALARA objectives are met
- Administer Personnel Dosimetry programs
- Perform instrument calibration and testing
- Provide ALARA review of site procedure and monitoring of operations
- Perform radiological safety training and refresher training
- Maintain records of the Radiation Protection program, including audit and other reviews of program content and implementation, radiation surveys, instrument calibrations, individual monitoring results, and records required for decommissioning

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-12.3

Provide a description of the ALARA design and operation considerations for the facility beyond those described for the storage systems.

The SAR includes, by reference, descriptions of the ALARA considerations for design and operations of the storage systems. However, the SAR does not appear to address ALARA considerations for the design and operations aspects of the CISF that are in addition to the storage systems. These considerations should be described for facility aspects such as the off-normal holding area, the cask handling building, and the wash down pad/area in terms of items such as facility and building layout, operations of facility equipment, locations verse the controlled area boundary and locations where personnel or individuals that are not radiation workers would be likely to be or are permitted to be.

This information is needed to determine compliance with 10 CFR 72.126(a) and 10 CFR 20.1101.

WCS Response to RSI 12.3:

WCS has provided the requested information in Chapter 9, Section 9.3.3.1 of the WCS SAR.

WCS SAR Impact:

Additions and deletions in WCS SAR Chapter 9 Section 9.3.3.1

9.3.3.1 Cask Handling Building Shielding

The ALARA considerations for the CISF Cask Handling Building are the same as the transportation casks since the canisters will still be in the transportation cask. While shielding is provided by the Cask Handling Building no credit is taken in the shielding/exposure analysis. ~~The Cask Handing Building itself does not provide shielding that is credited in the any of the shielding/exposure analysis.~~ Shielding from the radiation sources within the canisters is provided by the Transportation/Transfer Casks, Transfer Casks and Storage Overpacks. The Table 9-4 provides the cross reference to the applicable appendix and section for each canister/storage overpack where each system is discussed.

As described in Section 9.4 of the SAR, the dose to the workers due to a loading operation is estimated based upon dose rate information in existing storage FSARs and transportation cask SARs and is listed in Appendix A-9, specifically Table A.9-2 and Table A.9-3 for the respective configurations.

WCS will use stackable shield blocks to establish low dose areas during cask offloading operations to maintain radiation doses ALARA. The shield blocks are constructed out of 2,000 psi concrete and measuring approximately 2’Hx4’Lx2’W and provide 9.83 half value layers of shielding. Administrative/Process controls will be implemented for the Cask Handling Building to establish an exclusion zone during offloading operations for the exterior of the building and rail area. Specifically WCS will exclude workers from the Administrative Storage/Office Area and Cask Storage and Maintenance Area during off loading of canisters (See Figure 9-4).

The CISF boundary will be posted and controlled as a “restricted area, radioactive material area, dosimetry and RWP required for entry”. The CISF Cask Handling Building will be posted and controlled as a radiation area or high radiation area per 10 CFR Part 20.

CISF personnel involved in canister handling activities will be trained in accordance with 10 CFR Part 19. These workers are considered “Radiation Workers” and the occupational radiation dose limits specified in 10 CFR Part 20 Subpart C apply.

9.3.2.2 Restricted Area

The restricted area is located on the site such that a minimum distance from any stored SNF to the security boundaries is at least 330 feet in order to maintain exposures to the public within regulatory limits. The nearest property boundary is more than 4,300 feet from the Storage Area.

9.3.3 Shielding

Shielding design features are discussed in this section.

9.3.3.1 Cask Handling Building Shielding

The ALARA considerations for the CISF Cask Handling Building are the same as the transportation casks since the canisters will still be in the transportation cask. While shielding is provided by the Cask Handling Building no credit is taken in the shielding/exposure analysis. Shielding from the radiation sources within the canisters is provided by the Transportation/Transfer Casks, Transfer Casks and Storage Overpacks. The Table 9-4 provides the cross reference to the applicable appendix and section for each canister/storage overpack where each system is discussed.

As described in Section 9.4 of the SAR, the dose to workers due to a loading operations is estimated based upon dose rate information in existing storage FSARS and transportation cask SARs and is listed in Appendix A-9, specifically Table A.9-2 and Table A.9-3 for the respective configurations.

WCS will use stackable shield blocks to establish low dose areas during cask offloading operations to maintain radiation doses ALARA. The shield blocks are constructed out of 2,000psi concrete and measuring approximately 2’H x 4’L x 2’W and provide 9.83 half value layers of shielding. Administrative/Process controls will be implemented for the Cask Handling Building to establish an exclusion zone during offloading operations for the exterior of the building and rail area. Specifically WCS will exclude workers from the Administrative Storage/Office Area and Csk Storage and Maintenance Area during off loading of canisters. See Figure 9-4, WCS Cask Handling Building.

The CISF protected area boundary will be posted and controlled as a “restricted area, radioactive material area, dosimetry and RWP required for entry”. The CISF Cask Handling Building will be posted and controlled as a radiation are or high radiation are per 10 CFR Part 20.

CISF personnel involved in canister handling activities will be trained in accordance with 10 CFR Part 19. These workers are considered “Radiation Workers” and the occupation radiation dose limits specified in 10 CFR Part 20 Subpart C apply.

9.3.3.2 Receiving Area Shielding

Shielding is provided by the 10 CFR Part 71 certified transportation cask.

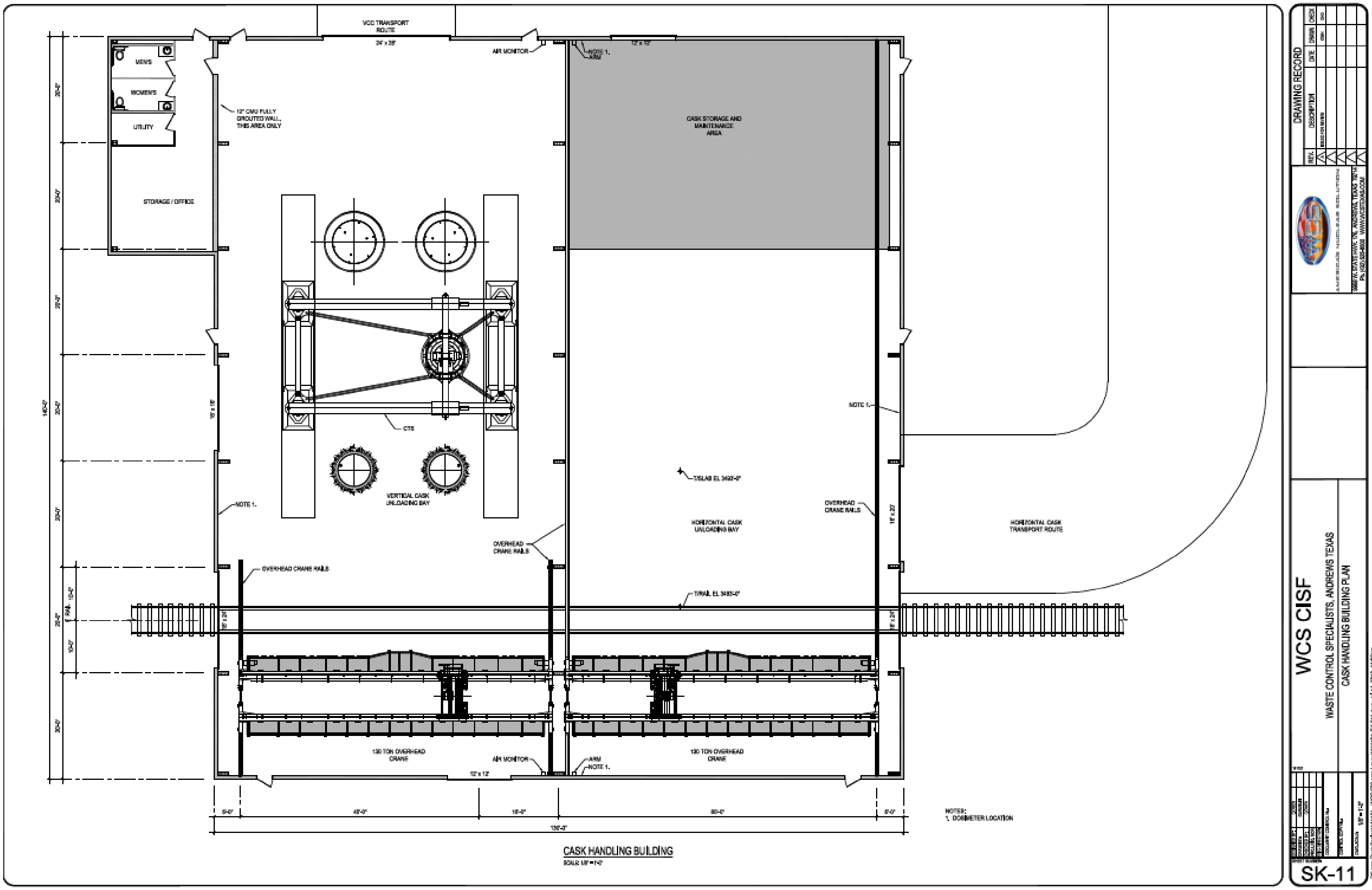


Figure 9-4 WCS CISF Cask Handling Building

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

<u>RSI NP-12.4</u>

Provide the following:

a. the dose contributions from other radioactive material facilities to the annual doses for the proposed CISF
b. an analysis of annual doses to members of the public working around the proposed CISF
c. information or analysis to address all of the annual dose limits in 10 CFR 72.104(a)

The annual dose limits specified in 10 CFR 72.104 include contributions not only from the proposed facility but also other facilities in the region. The limits in 10 CFR 72.104(a) are similar to those in 40 CFR 191.03, which also apply to the proposed CISF. The region around the CISF includes facilities such as the LES National Enrichment Facility and the existing WCS low level radioactive waste facilities (the red, yellow, blue, and green areas of SAR Figure 2-1). The area around the proposed CISF includes operations such as a quarry, a public landfill and the WCS's RCRA and TSCA operations. The SAR should demonstrate that the annual dose limits for members of the public are met for individuals employed at these facilities. Additionally, along with a whole body dose limit, 10 CFR 72.104(a) includes dose limits for the thyroid and any other critical organ, which have not been addressed in the SAR.

This information is needed to determine compliance with 10 CFR 72.104(a) and 40 CFR 191.03.

<u>WCS Response to RSI 12.4:</u>

WCS has provided the requested information in a new section 9.4.3, in Chapter 9 of the WCS SAR.

<u>WCS SAR Impact:</u>

Added section 9.4.3, a mark-up of the SAR is provided below.

New Section starting on page 9-13 of the WCS SAR:

9.4.3 <u>Dose Contributions from Other Radioactive Material Facilities</u>

9.4.3.1 <u>Contributions to the Annual Doses for the Proposed CISF</u>

Pursuant to 10 CFR 72.104, *Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS,* licensees are required to constrain the concentrations of radioactive materials in effluents and direct radiation from an ISFSI or MRS such that during normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the controlled area does not exceed 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid and 0.25 mSv (25 mrem) to any other critical organ. Similar standards are included in 40 CFR 191.03. These dose constraints not only apply to releases of radioactive materials and direct radiation from an ISFSI or MRS, but also to releases from other sources of radiation from uranium fuel cycle operations in the region. Accordingly, WCS must ensure that the annual dose to any real individual who is located outside the controlled area boundary does not exceed the specified annual dose equivalent limit for releases of radioactive materials and direct radiation, not only from the CISF, but also from all other operations at WCS and those attributable to the National Enrichment Facility (NEF) located near Eunice, New Mexico and operated by URENCO USA (Figure 9-5).

9.4.3.2 Annual Dose to the Members of the Public Working Around the CISF

WCS has established a comprehensive Environmental Monitoring Program to assess the radiological impacts to human health and the environment attributable to operations at its Treatment, Storage and Disposal Facility, and its disposal operations for 11.e(2) byproduct materials, as well as for Class A, B, and C LLW. The Environmental Monitoring Program was established to demonstrate compliance with applicable radiation protection standards attributable to all operations at WCS. Additionally, radiological dose assessments are conducted using data collected as part of the environmental monitoring program using the RACER (Risk Analysis, Communication, Evaluation, and Reduction) Data Analysis Tool (DAT) online application (www.raceratwcs.com). RACER provides a framework for managing and analyzing environmental monitoring data related to WCS. In addition to evaluating temporal and spatial trends in data, RACER allows measurement data to be combined with exposure parameters and dose coefficients to estimate dose. A report has been developed within the RACER application to specifically estimate annual dose to a hypothetical member of the public based on radionuclide measurements made in air and soil, as well as results from deployed environmental dosimeters.

9.4.3.3 Annual Dose Limits to an Individual

~~a.~~ WCS has evaluated the radiological impacts attributable to its present operations, those from the NEF, and radiation doses estimated for storing up to 40,000 MTUs of SNF at the CISF. While WCS is requesting authorization to only store 5,000 MTUs of SNF in its license application, it bounded the cumulative radiological impacts of storing up to 40,000 MTUs of SNF consistent with its plan to expand the CISF in the future. WCS estimated the cumulative radiation effective doses attributable to its present operations, the NEF, and the CISF to any real person that could be present at Sundance Services, Permian Basin Materials (previously known as Wallach Concrete), and the nearest neighbor (Figure 9-5). To assess the annual dose from the NEF, WCS relied on information provided in Section 4.2.12.2, *Operations*, of the NEF Environmental Report, Revision 4, published in April 2005 (ADAMS Accession No. ML060680657). The maximum annual dose to any real individual who is located beyond the controlled area attributable to operations at the NEF was estimated at 0.026 mSv (2.6 mrem). The bounding annual dose equivalent reporting by NEF includes the direct radiation attributable to Uranium Byproduct Cylinder Pads estimated to occur over the lifespan of the NEF facility. The results of the annual radiation doses to any real person that could be present at Sundance Services, Permian Basin Materials, and the nearest neighbor location, respectively, are presented in Table 9-7.

The RACER dose module was used to calculate the WCS airborne pathway (particulates and ^{129}I) and direct radiation dose using available air and dosimeter data from 2015. The airborne pathway doses shown in Table 1 represent the maximum net dose for the perimeter stations in the northwest quadrant. The net dose potentially attributable to WCS operations is estimated as the perimeter quadrant dose minus the background dose. The perimeter quadrant dose is based on data collected at the perimeter stations in the quadrant, and the background dose is based on data collected at the background sampling location (Station #9). The airborne particulate and ^{129}I dose at the receptors would be less than the perimeter stations dose due to atmospheric dispersion. As such, the annual dose equivalent to the thyroid will be less than 0.75 mSv (75 mrem). Direct radiation doses are calculated in a similar manner.

Net direct radiation from WCS operations at the perimeter for 2015 ranged from background in the northeast quadrant to 0.06 mSv/yr (6.6 mrem/yr) in the southwest quadrant. Even though the dose from external radiation at the perimeter is less than the 0.25 mSv/yr (25 mrem/yr) limit, no receptor is present there. The doses were therefore reduced by attenuation to the applicable receptors as discussed below using the CISF dose rate modeling.

Direct radiation doses from the CISF were calculated by NAC International (2015). A graph of the dose rate as a function of distance from the center storage pads out to a distance of 1000 m was provided. This curve was extrapolated to further distances through log-transformed linear regression of the data. The regression equation was given by (r^2 = 0.992)

$$D(x) = \exp[-0.00999(x - 260) + 11.548]$$

where x is the distance in meters from the center of the pad ($x \geq 260$) and $D(x)$ is the dose rate as a function of distance (mSv/yr (mrem/yr)). The attenuation factor from x = 260 m to x = 1,900 m was 4.1×10^{-9} [i.e., D(1900 m)/D(260 m)]. Thus, using the attenuation factor of 4.1×10^{-9} at 1.9 km results in a dose no greater than background at this or greater distances.

The results from this analysis demonstrate that the cumulative impacts from operations at these facilities located in the region where the CISF will be located are less than the annual dose equivalent limit of 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other critical organ, as specified in 10 CFR 72.104.

Added Figure:

Figure 9-5. Receptors and Source of Radiation in the Region of Interest

Added Table:

Table 9-7. Estimated Cumulative Annual Dose Equivalent for All Sources of Radiation in the Region

Added References:

Section 4.2.12.2, *Operations*, of the NEF Environmental Report, Revision 4, published in April 2005 (ADAMS Accession No. ML060680657

NAC International, 2015. Scoping Evaluation for WCS; Site Boundary Dose Rate Evaluation. Prepared by John Ritchie, August 28th, 2015.

9.4.1.3 Air Scattered Dose Rate

The air scattered or skyshine dose rate is provided in Table 9-5 and Table 9-6 in the "Skyshine" column and is estimated by subtracting the direct dose rate from the total dose rate. It may be observed that the direct dose rate is dominant close to the storage overpacks (< 20 m) but skyshine becomes dominant farther from the storage overpacks (> 20 m).

9.4.2 Doses to Workers

Section 2.1 of the Technical Specifications [9-13] lists the NRC approved canisters authorized for storage at the WCS CISF. Table 9-4 provides the cross reference to the applicable appendix and section for each canister/storage overpack where the Occupational Exposure for each system is discussed. The NUHOMS® systems do not require workers to approach the modules to perform surveillance of maintenance activities, therefore the only occupational exposure associated with the NUHOMS® systems is placing the canisters into storage and retrieving them again for off-site shipment. For the vertical systems the applicable appendices listed in Table 9-4 provide occupational exposures due to surveillance activities required for the VCCs

9.4.3 Dose Contributions to the Annual Doses for the Proposed CISF

9.4.3.1 Contributions to the Annual Doses for the Proposed CISF

Pursuant to 10 CFR 72.104, *Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS,* licensees are required to constrain the concentrations of radioactive materials in effluents and direct radiation from and ISFSI or MRS such that during normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the Owner Controlled Area does not exceed 0.25mSv (25mrem) to the whole body, 0.75mSv (75 mrem) to the thyroid and 0.25mSv (0.25 mrem) to any other critical organ. Similar standards are included in 40 CFR 191.03. These dose constraints not only apply to releases of radioactive materials and direct radiation from an ISFSI or MRS, but also to releases of radiation from uranium fuel cycle operations in the region. Accordingly, WCS must ensure that the annual dose to any real individual who is located outside the Owner Controlled Area boundary does not exceed the specified annual dose equivalent limit for releases of radioactive materials and direct radiation, not only from the CISF; but also from all other operations at WCs and those attributable to the National Enrichment Facility (NEF) located near Eunice, New Mexico and operated by URENCO USA see Figure 9-5, WCS CISF Receptors and Source of Radiation in the Region of Interest.

9.4.3.2 Annual Dose to the Members of the Public Working Around the CISF

WCS has established a comprehensive Environmental Monitoring Program to assess the radiological impacts to human health and the environment attributable to operations at its Treatment, Storage and Disposal Facility, and its disposal operations for 11.e. (2) byproduct materials, as well as for Class A, B, C, and LLW. The Environmental Monitoring Program was established to demonstrate compliance with applicable radiation protection standards attributable to all operations at WCS. Additionally, radiological dose assessments are conducted using data collected as part of the Environmental Monitoring Program using the RACER (Risk Analysis, Communication, Evaluation, and Reduction) Data Analysis Tool (DAT) online application (www.raceratwcs.com) RACER provides a framework for managing and analyzing environmental monitoring data related to WCS. In addition to evaluation temporal and spatial trends in data, RACER allow measurement data to be combined with exposure parameters and dose coefficients to estimate dose. A report has been developed within the RACER application to specifically estimate annual dose to a hypothetical member of the public based on radionuclide measurements made in air and soil, as well as results from deployed environmental dosimeters.

9.4.3.3 Annual Dose Limits to an Individual

WCS has evaluated the radiological impacts attributable to its present operations, those from the NEF, and radiation doses estimated for storing up to 40,000 MTUs of SNF at the CISF. While WCS is requesting authorization to only store 5,000 MTUs of SNF in its license application, it bounded the cumulative radiological impacts of storing up to 40,000 MTUs of SNF consistent with its plan to expand the CISF in the future. WCS estimated the cumulative radiation effective doses attributable to its present operations, the NEF, and the CISF to any real person that could be present at Sundance Services, Permian Basin Materials (Previously known as Wallach Concrete), and the nearest neighbor Figure 9-5, WCS CISF Receptors and Source of Radiation in the Region of Interest.. To assess the annual dose from the NEF, WCS relied on information provided in Section 4.2.12.2, *Operations*, of the NEF Environmental Report, Revision 4, published in April 2005 (ADAMS Accession No. ML060680657). The maximum annual dose to any real individual who is located beyond the controlled area attributable to operations at the NEF was estimated at 0.026 mSv (2.6 mrem). The bounding annual dose equivalent reporting by NEF includes the direct radiation attributable to Uranium Byproduct Cylinder Pads estimated to occur over the lifespan of the NEF facility. The results of the annual radiation doses to any real person that could be present at Sundance Services, Permian Basin Materials (Previously known as Wallach Concrete), and the nearest neighbor location, respectively, are presented in Table. The RACER dose module was used to calculate the WCS airborne pathway (particulates and 129I) and direct radiation dose using available air and dosimeter data from 2015. The airborne pathway doses shown in Table 9-7, Estimated Cumulative Annual Dose Equivalent for All Sources of Radiation in the Region, represent the maximum net dose for the perimeter stations in the northwest quadrant. The net dose potentially attributable to WCS operations is estimated as the perimeter quadrant dose minus the background dose. The perimeter quadrant dose is based on data collected at the perimeter stations in the quadrant, and the background dose is based on data collected at the background sampling location (Station #9). The airborne particulate and 129I dose at the receptors would be less than the perimeter stations dose due to atmospheric dispersion. As such, the annual dose equivalent to the thyroid will be less than 0.75 mSv (75 mrem). Direct radiation doses are calculated in a similar manner. Net direct radiation from WCS operations at the perimeter for 2015 ranged from background in the northeast quadrant to 0.06 mSv/yr (6.6 mrem/yr) in the southwest quadrant. Even though the dose from external radiation at the perimeter is less than the 0.25 mSv/yr (25 mrem/yr) limit, no receptor is present there. The doses were therefore reduced by attenuation to the applicable receptors as discussed below using the CISF dose rate modeling.

Direct radiation doses from the CISF were calculated by NAC International (2015). A graph of the dose rate as a function of distance from the center storage pads out to a distance of 1000 m was provided. This curve was extrapolated to further distances through log-transformed linear regression of the data. The regression equation was given by (r2 = 0.992)

$$D(x) = \exp\left[-0.00999(x-260)+11.548\right]$$

where x is the distance in meters from the center of the pad (x $\geq$260) and D(x) is the dose rate as a function of distance (mSv/yr (mrem/yr)). The attenuation factor from x = 260 m to x = 1,900 m was 4.1×10^{-9} [i.e., D(1900 m)/D(260 m)]. Thus, using the attenuation factor of 4.1×10^{-9} at 1.9 km results in a dose no greater than background at this or greater distances.

The results from this analysis demonstrate that the cumulative impacts from operations at these facilities located in the region where the CISF will be located are less than the annual dose equivalent limit of 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other critical organ, as specified in 10 CFR 72.104.

.

9.7 References

9-1 AREVA TN Document, NUH09.101 Rev. 17, "NUHOMS® -MP197 Transportation Package Safety Analysis Report." (Basis for NRC CoC 71-9302).

9-2 AREVA TN Document NUH-05-151 Rev. 17, "NUHOMS®-MP187 Multi-Purpose Transportation Package Safety Analysis Report." (Basis for NRC CoC 71-9255).

9-3 "Rancho Seco Independent Spent Fuel Storage Installation, Final Safety Analysis Report, Volume I, ISFSI System," NRC Docket No. 72-11, Revision 4.

9-4 AREVA TN Document NUH-003, Revision 14, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel." (Basis for NRC CoC 72-1004).

9-5 AREVA TN Document, ANUH-01.0150, Revision 6, "Updated Final Safety Analysis Report for the Standardized Advanced NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, NRC Docket No. 72-1029.

9-6 NAC International, "NAC-STC, NAC Storage Transport Cask Safety Analysis Report," Revision 17, CoC 9235 Revision 13, USNRC Docket Number 71-9235.

9-7 NAC International, "Safety Analysis Report for the UMS® Universal Transport Cask," Revision 2, CoC 9270 Revision 4, USNRC Docket Number 71-9270.

9-8 NAC International, "Safety Analysis Report for the MAGNATRAN Transport Cask," Revisions 12A, 14A, and 15A, USNRC Docket Number 71-9356.

9-9 NAC International, "NAC Multipurpose Cask Final Safety Analysis Report," Revision 10, CoC 1025 Revision 6, USNRC Docket Number 72-1025.

9-10 NAC International, "Final Safety Analysis Report for the UMS Universal Storage System," Revision 10, CoC 72-1015 Revision 5, USNRC Docket Number 72-1015.

9-11 NAC International, "MAGNASTOR® Final Safety Analysis Report," Revision 6, CoC 1031 Revision 4, USNRC Docket Number 72-1031.

9-12 NRC Spent Fuel Project Office, Interim Staff Guidance, ISG-5, Rev. 1, "Confinement Evaluation."

9-13 Proposed SNM-1050, WCS Interim Storage Facility Technical Specifications, Amendment 0.

9-14 Section 4.2.12.2, *Operations,* of the NEF Environmental Report, Revision 4, published in April 2005 (ADAMS Accession No. ML060680657)

9-15 NAC International, 2015. Scoping Evaluation for WCS, Site Boundary Dose Rate Evaluation, Prepared by John Ritchie, August 28th , 2015.

Table 9-7
Estimated Cumulative Annual Dose Equivalent for All Sources of Radiation in the Region

Receptor	Source[a]	Airborne Pathway mSv (mrem)	Direct Radiation mSv (mrem)	Annual Dose Equivalent mSv (mrem)
Sundance Services	WCS Operations	$<6.3 \times 10^{-3}$ (<0.63)[b]	$<1 \times 10^{-7}$ ($<1 \times 10^{-5}$)[c]	$<6.3 \times 10^{-3}$ (<0.63)
	CISF	N/A	5.7×10^{-5} (5.7×10^{-3})[d]	5.7×10^{-5} (5.7×10^{-3})
	NEF	2.6×10^{-5} (2.6×10^{-3})	0.026 (2.6)	0.026 (2.6)
Permian Basin Materials (Formerly Wallach Concrete)	WCS Operations	$<6.3 \times 10^{-3}$ (<0.63)[b]	$<1 \times 10^{-7}$ ($<1 \times 10^{-5}$)[c]	$<6.3 \times 10^{-3}$ (<0.63)
	CISF	N/A	2.3×10^{-6} (2.3×10^{-4})[d]	2.3×10^{-6} (2.3×10^{-4})
	NEF	2.2×10^{-5} (2.2×10^{-3})	0.021 (2.1)	0.021 (2.1)
Nearest Receptor	WCS Operations	$<6.3 \times 10^{-3}$ (<0.63)[b]	$<1 \times 10^{-7}$ ($<1 \times 10^{-5}$)[c]	$<6.3 \times 10^{-3}$ (<0.63)
	CISF	N/A	$<1 \times 10^{-6}$ ($<1 \times 10^{-4}$)[d]	$<1 \times 10^{-6}$ ($<1 \times 10^{-4}$)
	NEF	1.3×10^{-5} (1.3×10^{-3})	$<1 \times 10^{-6}$ ($<1 \times 10^{-4}$)	$<1.3 \times 10^{-5}$ ($<1.3 \times 10^{-3}$)
NEF	WCS Operations	$<6.3 \times 10^{-3}$ (<0.63)[b]	$<1 \times 10^{-7}$ ($<1 \times 10^{-5}$)[c]	$<6.3 \times 10^{-3}$ (<0.63)
	CISF	N/A	$<1 \times 10^{-6}$ ($<1 \times 10^{-4}$)[d]	$<1 \times 10^{-6}$ ($<1 \times 10^{-4}$)
	NEF	1.7×10^{-4} (1.7×10^{-2})	<0.2 (<20)	<0.2 (<20)
Lea Co Landfill	WCS Operations	$<6.3 \times 10^{-3}$ (<0.63)[b]	$<1 \times 10^{-7}$ ($<1 \times 10^{-5}$)[c]	$<6.3 \times 10^{-3}$ (<0.63)
	CISF	N/A	$<1 \times 10^{-6}$ ($<1 \times 10^{-4}$)[d]	$<1 \times 10^{-6}$ ($<1 \times 10^{-4}$)
	NEF	$<1.7 \times 10^{-4}$ ($<1.7 \times 10^{-2}$)	<0.2 (<20)	<0.2 (<20)

[a] Uranium fuel cycle facilities in the region
[b] Based on net dose for perimeter stations in northwest quadrant
[c] Based on attenuation of gamma dose rate as a function of distance for the CISF, see footnote d
[d] Based on extrapolation of the attenuation in gamma dose rate as a function of distance provided in NAC International (2015)

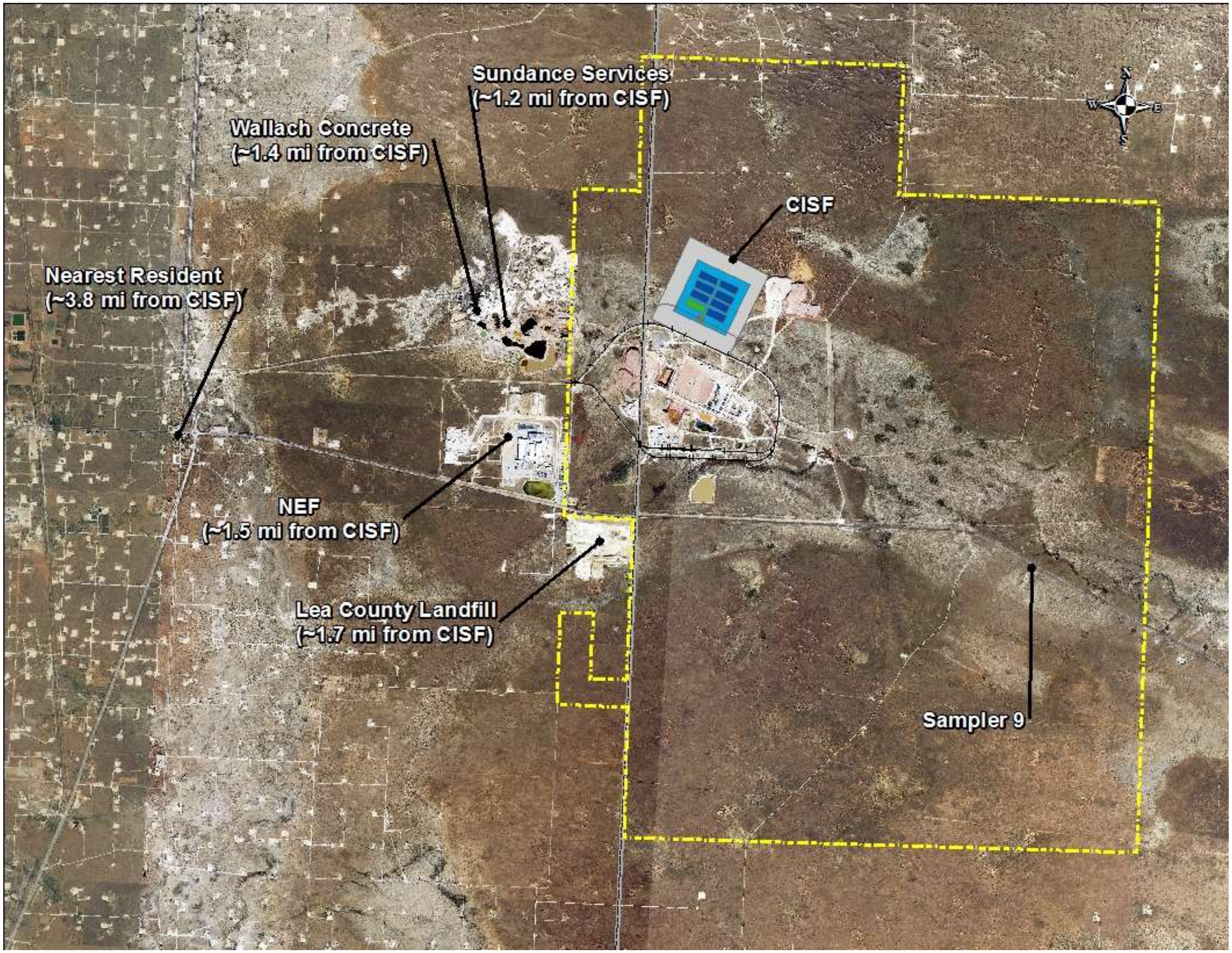


Figure 9-5 WCS CISF Receptors and Source of Radiation in the Region of Interest

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-12.5:

Describe how compliance with 10 CFR 20.1301 limits will be ensured and doses will be maintained ALARA for personnel/individuals on site that are not radiation workers.

It is not clear that the SAR addresses radiation protection for individuals and personnel that are or may be on site but are not radiation workers. The 10 CFR Part 20 dose limits for members of the public apply to these individuals even on site. Such individuals include security and administrative staff that are not trained radiation workers and individuals such as railroad personnel delivering or picking up spent fuel and GTCC waste transport packages.

This information is needed to determine compliance with 10 CFR 20.1101 and 10 CFR 20.1301.

WCS Response to RSI 12.5:

WCS has provided the requested information in Chapter 9, Section 9.1.1 of the WCS SAR.

WCS SAR Impact:

Added to WCS SAR Chapter 9, Section 9.1.1 on page 9-2.

9.1.1 Policy Considerations

The WCS CISF is designed and operated to provide radiation protection for workers in conformance with applicable regulatory criteria so that occupational radiation exposures are maintained ALARA.

Operation of the WCS CISF is in accordance with an ALARA policy that includes, as a minimum, the following criteria.

- Maintain radiological releases and exposures to personnel below the applicable limits of 10 CFR Part 20.
- Ensure that all exposures are kept ALARA, with technological, economic and social factors taken into consideration.
- Integrate appropriate radiation protection controls into all work activities.
- Ensure that all personnel understand and follow ALARA procedures.
- Restrict access to radiological controlled areas.~~radiation areas.~~
- Track individual and collective doses to identify trends and causes.
- Conduct periodic training and exercises for management, radiation workers and other site personnel in radiation protection principles and procedures, individual and group protective measures, site procedures and emergency response.
- ntegrate ALARA considerations into the WCS CISF design and procedure change activities.

CISF personnel including administration and security staff and railroad personnel involved in the delivery to and shipment from the CISF of transport packages will be trained in accordance with 10 CFR Part 19. These workers are considered “Radiation Workers” and the occupational radiation dose limits specified in 10 CFR Part 20 Subpart C. Individuals (visitors) that are not trained in accordance with 10 CFR Part 19 are considered members of the public and the dose limits specified 10 CFR Part 20.1301 apply.

WCS minimizes radiation dose to non-radiation workers by the follow means:

- WCS will control the number of non-radiation workers admitted to both the Owner Controlled Area (OCA) and to the CISF.
- Commercial and industrial deliveries to WCS will be required to be accepted outside the OCA, for further transfer on site by radiation workers.
- Authorized visitors and other members of the public will be under escort while on the OCA and the CISF.
- Visitors will receive orientation training on minimizing radiation exposure and emergency procedures.

9.1 Ensuring That Occupational Radiation Exposures Are ALARA

9.1.1 Policy Considerations

The WCS CISF is designed and operated to provide radiation protection for workers in conformance with applicable regulatory criteria so that occupational radiation exposures are maintained ALARA.

Operation of the WCS CISF is in accordance with an ALARA policy that includes, as a minimum, the following criteria.

- Maintain radiological releases and exposures to personnel below the applicable limits of 10 CFR Part 20.
- Ensure that all exposures are kept ALARA, with technological, economic and social factors taken into consideration.
- Integrate appropriate radiation protection controls into all work activities.
- Ensure that all personnel understand and follow ALARA procedures.
- Restrict access to radiologically controlled areas.
- Track individual and collective doses to identify trends and causes.
- Conduct periodic training and exercises for management, radiation workers and other site personnel in radiation protection principles and procedures, individual and group protective measures, site procedures and emergency response.
- Integrate ALARA considerations into the WCS CISF design and procedure change activities.

CISF personnel including administration, security staff and railroad personnel involved in the delivery to and shipment from the CISF of transport packages will be trained in accordance with 10 CFR Part 19. These workers are considered “Radiation Workers” and the occupational radiation dose limits specified in 10 CFR Part 20 Subpart C apply. Individuals (visitors) not trained in accordance with 10 CFR Part 19 are considered members of the public and the dose limits specified in 10 CFR 20.1301 apply.

WCS minimizes radiation dose to non-radiation workers by the following means:

- WCS will control the number of non-radiation workers admitted to both the Owner Controlled Area (OCS) and to the CISF.
- Commercial and industrial deliveries to WCS will be required to be accepted outside the OCA, for further transfer on site by radiation workers.
- Authorized visitors and other members of the public will be under escort while in the OCA and the CISF.
- Visitors will receive orientation training on minimizing radiation exposure and emergency procedures.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-12.6

Provide an evaluation of the doses for unloading a canister from a storage system at the WCS CISF, loading it into a transportation package, and preparing the package for shipment.

A review of Chapter D.9 of the SAR indicates that the dose evaluations for the described operations are missing for the spent fuel and GTCC waste storage containers intended to be used at the proposed CISF.

This information is needed to determine compliance with 10 CFR 72.24(e) and 10 CFR 72.126.

WCS Response to RSI 12.6:

WCS has provided the requested information in Appendices A – D of the WCS SAR.

The dose evaluation for loading operations for receipt and transfer of a 61 BTH Type 1 DSC to HSM Model 102 using the MP197HB cask is provided in CISF SAR Section D.9.2.2. The total collective dose for unloading a 61BTH Type 1 DSC from an HSM Model 102 and preparing it for transport off-site is bounded by the loading operations. Operations for removing the 61BTH Type 1 DSC from the HSM Model 102 and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. Chapter D.9 of the CISF SAR will be revised to explain this.

Conforming changes will be made to in sections Chapters A.9, B.9, and C.9.

WCS SAR Impact:

Appendices A – D, Sections A.9.2.2, B.9.2.2, C.9.2.2 and D.9.2.2 of the CISF WCS SAR, mark-ups are provided below:

Added to Appendix A Section A.9.2.2, Page C.9-4:

The total collective dose for unloading a FO-, FC-, or FF-DSC or reactor related GTCC wastes canister from an HSM Model 80 and preparing it for transport off-site is bounded by the loading operations (1057 person-mrem). Operations for removing these canisters from the HSM Model 80 and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2114 person-mrem.

Added to Appendix B Section B.9.2.2, Page B.9-4:

The total collective dose for unloading a 24PT1 DSC or reactor related GTCC waste canister from an AHSM and preparing it for transport off-site is bounded by the loading operations (1097 person-mrem). Operations for removing the canister from the AHSM and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2194 person-mrem.

Added to Appendix C Section C.9.2.2, Page C.9-4:

The total collective dose for unloading a 61BT DSC from an HSM Model 102 and preparing it for transport off-site is bounded by the loading operations (1016 person-mrem). Operations for removing the 61BT DSC from the HSM Model 102 and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2032 person-mrem.

Added to Appendix D Section D.9.2.2, Page D.9-4:

The total collective dose for unloading a 61BTH Type 1 DSC from an HSM Model 102 and preparing it for transport off-site is bounded by the loading operations (1016 person-mrem). Operations for removing the 61BTH Type 1 DSC from the HSM Model 102 and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2032 person-mrem.

The total collective dose for an operation is the sum of the receipt and transfer collective doses. The total collective dose for receipt and transfer of FO-, FC-, or FF-DSC or GTCC waste canister to an HSM Model 80 using the MP187 cask: 1057 person-mrem.

The total collective dose for unloading, an FO-, FC-, or FF-DSC or reactor related GTCC waste canister from an HSM Model 80 and preparing it for transport off-site is bounded by the loading operations (1057 person-mrem). Operations for removing these canisters from the HSM Model 80 and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2114 person-mrem.

- For transfer of the 24PT1 DSC inside the MP187 cask, bounding dose rates for transfer of the 24PT1 DSC inside the OS197 transfer cask are utilized. This approach is conservative because the OS197 transfer cask contains less shielding than the MP187 cask.

The configurations used in the dose rate analysis are summarized in Table B.9-1. Results for the various loading scenarios are provided in Table B.9-2 and Table B.9-3. Separate tables are developed for receipt and transfer operations. These tables provide the process steps, number of workers, occupancy time, distance, dose rate, and collective dose for all operations.

The total collective dose for an operation is the sum of the receipt and transfer collective doses. The total collective dose for receipt and transfer of NUHOMS®-24PT1 DSC or GTCC waste canister to an AHSM using the MP187 cask: 1097 person-mrem.

The total collective dose for unloading a 24PT1 DSC or reactor related GTCC waste canister from an AHSM and preparing it for transport off-site is bounded by the loading operations (1097 person-mrem). Operations for removing the canister from the AHSM and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2194 person –mrem.

- For receipt of the 61BT DSC inside the MP197HB cask, bounding dose rates for receipt of the 69BTH DSC inside the MP197HB cask are utilized. This approach is conservative because the 69BTH DSC contains a larger source than the 61BT DSC.
- For transfer of the 61BT DSC inside the MP197HB cask, bounding dose rates for transfer of the 69BTH DSC inside the OS200 transfer cask are utilized. This approach is conservative because the OS200 transfer cask contains less shielding than the MP197HB cask, and the 69BTH DSC contains a larger source than the 61BT DSC.

The configurations used in the dose rate analysis are summarized in Table C.9-1. Results for the various loading scenarios are provided in Table C.9-2 and Table C.9-3. Separate tables are developed for receipt and transfer operations. These tables provide the process steps, number of workers, occupancy time, distance, dose rate, and collective dose for all operations.

The total collective dose for an operation is the sum of the receipt and transfer collective doses. The total collective dose for receipt and transfer of NUHOMS®-61BT DSC or GTCC waste canister to an HSM Model 102 using the MP197HB cask: 1016 person-mrem.

The total collective dose for unloading a 61BT DSC from an HSM Model 102 and preparing it for transport off-site is bounded by the loading operations (1016 person-mrem).Operations for removing the 61BT DSC from the HSM Model 102 and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of the receipt, transfer, retrieval, and shipment is 2032 person-mrem.

- For transfer of the 61BTH Type 1 DSC inside the MP197HB cask, bounding dose rates for transfer of the 69BTH DSC inside the OS200 transfer cask are utilized. This approach is conservative because the OS200 transfer cask contains less shielding than the MP197HB cask, and the 69BTH DSC contains a larger source than the 61BTH Type 1 DSC.

The configurations used in the dose rate analysis are summarized in Table D.9-1. Results for the various loading scenarios are provided in Table D.9-2 and Table D.9-3. Separate tables are developed for receipt and transfer operations. These tables provide the process steps, number of workers, occupancy time, distance, dose rate, and collective dose for all operations.

The total collective dose for an operation is the sum of the receipt and transfer collective doses. The total collective dose for receipt and transfer of 61BTH Type 1 DSC to an HSM Model 102 using the MP197HB cask: 1016 person-mrem.

The total collective dose for unloading a 61BTH Type 1 DSC from an HSM Model 102 and preparing it for transport off-site is bounded by the loading operations (1016 person-mrem). Operations for removing the 61BTH Type 1 DSC from the HSM Model 102 and off-site shipment are identical to loading operations, except in reverse order. The collective dose for unloading is bounded because during storage at the WCS CISF the source terms will have decayed reducing surface dose rates. The total collective dose is the sum of receipt, transfer, retrieval, and shipment is 2032 person-mrem.

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI NP-18.1:

In Section 1.1 of the ER, WCS states that it “is requesting authorization to store up to 5,000 MTU in Phase 1, but has analyzed the environmental impacts of storing up to 40,000 MTU at the CISF.” WCS further states that “[t]he CISF would be constructed in eight phases over 20 years” (ER section 2.22), “with one phase being completed approximately every 2.5 years.” (ER section 4.1). Each phase would be “sized to hold approximately 5,000 MTU for a total facility capacity of 40,000 MTU when all eight phases are complete” (ER section 2.22.2).

These statements imply that environmental impacts from construction and operation of the phases could be occurring at the same time over the course of the proposed 20-year construction period for the CISF. Additionally, Figure 2.26 of the ER shows the proposed layout of the 8 phases and how completed phases would be in close proximity to phases under construction.

It is not clear from the impact analysis in the ER whether WCS has addressed the integrated effects of construction and operation on the affected environment of all the eight phases or how the construction activities of future phases might impact the operation of the pads in operation.

WCS’s environmental analysis should address the integrated impacts to all resource areas of the affected environment from construction and operation of the eight phases over the anticipated CISF construction period (e.g., 20 years).

This information is needed to determine compliance with 10 CFR 51.45(b)(1)

WCS Response to RSI 18.1:

WCS has provided the requested information in the WCS ER added section below.

WCS Environmental Report Impact:

Add section to ER page 4-62

4.14 Integrated Environmental Impacts

WCS plans to license and construct the CISF in eight separate phases. Capacity for storage of approximately 5,000 MTUs of SNF and associated reactor related GTCC waste is planned in each of the eight phases. After the eighth phase is completed, approximately 40,000 MTUs of SNF and associated reactor related GTCC waste may be stored at the CISF. WCS analyzed the cumulative impacts for storing 40,000 MTUs of SNF and associated reactor related GTCC waste.

The cumulative environmental impacts for constructing and operating the CISF for all eight phases were analyzed in Chapter 4 of the Environmental Report. During Phase 1 of the project, the impacts from constructing the Security and Administration Building, Cask Handling Building, rail side track, and storage pads were analyzed. The environmental impacts associated with constructing Phase 1 of the CISF are bounding because the seven subsequent phases do not require construction of the Security and Administration Building, Cask Handling Building, and rail side track. The impacts of the seven subsequent phases would only include constructing the storage pads.

The Environmental Report addresses cumulative impacts to physical, biological, economic, and social parameters. In addition, the ER identifies resource uses, monitoring, potential mitigation measures, unavoidable adverse environmental impacts, the interaction between short-term uses of the environment and long-term productivity, and irreversible and irretrievable commitments of resources. Integrated impacts are presented in Table 4-14-1 for areas in which there are anticipated changes related to other activities that may arise from single or multiple actions and may result in additive or interactive effects (e.g., WCS low-level radioactive waste disposal license, NEF facility).

For transportation, the analysis in Section **4.2** includes cumulative impacts from other nearby operations. There would be small integrated adverse impacts to ecological resources as the impacts from the proposed CISF would be restricted to the site, and the proposed CISF takes up a small percentage of the habitat surrounding the site, thereby not significantly altering the integrated impacts already existing from other local and regional activities. There would be small integrated noise impacts because noise from activities at the proposed CISF would not impact any sensitive offsite receptors. There would be no integrated adverse impacts to cultural or historic resources. For visual/scenic resources, the analysis in Section **4.9** includes cumulative impacts from other nearby operations. Public and occupation health cumulative impacts are discussed in Section **4.12** and waste management cumulative impacts are discussed in Section **4.13**. The non-radiological integrated and environmental impacts are provided in Table 4.14-1.

WCS analyzed the incremental and cumulative radiological impacts associated with storing 5,000 MTUs of SNF during Phase 1. A separate analysis was also conducted to evaluate the cumulative radiological impacts associated with storing up to 40,000 MTUs. The results of the analysis are presented in Chapter 9, Section 9.4.1.2 and Tables 9-2, 9-4 and 9-5 of the WCS SAR. (NAC, 2015)

During construction of Phase 2, workers may be exposed to direct radiation from the SNF located on the Phase 1 storage pad. An analysis was performed to estimate the dose rate associated with storing 5,000 MTUs of SNF along the perimeter of Phase 1 Protected Area on workers constructing the next phase.

The ISFSI includes NAC vertical concrete casks (VCCs) that would provide some shielding from the HSMs to dose points where the VCCs are between the HSM array and the dose point. No credit is taken for VCCs. The neutron and gamma source terms are based on the maximum source term allowed under the Certificate of Compliance or specific license for the HSMs do not account for decay during storage at the originating site.

The analysis demonstrates that the dose rate approximately 600 ft from the center of Phase 1 was approximately 0.011 mSv/hr (1.1 mrem/hr). Thus, dose rates from the construction of Phase 2 after completion of Phase 1 would not be expected to exceed the dose rate limits of 0.02 mSv/hr (2 mrem/hr) for members of the general public at the perimeter of the Protected Area.

The anticipated dose rates during construction of Phases 3 through 8 are similar or less than those predicted to occur during construction of Phase 2, because the additional shielding provided by the loaded storage canisters and due to the increased distances from the loaded storage canisters and the storage pads under construction.

The results indicated that the maximum dose rates at the perimeter of the security zone in proximity of where the storage pads will be constructed during Phase 2 through Phase 8 are less than 0.02 mSv/hr (2 mrem/hr) as depicted in WCS SAR Chapter 9 Figures 9-1, 9-2 and 9-3. Accordingly, the analysis that was performed demonstrates that the interaction of workers that would be involved during the construction of Phase 2 through Phase 8 would not be exposed to direct radiation from SNF in storage at Phase 1 exceeding the 0.02 mSv/hr (2 mrem/hr) and 0.5 mSv/y (50 mrem/y) limit for members of the public, as specified in 10 CFR 20.1302(b)(2)(ii).The estimated dose rates around the perimeter of Phase are presented in Table 4.2-1.

Table 4.14-1 Integrated Impacts

	Construction	Operation	Integrated
Transportation	SMALL	SMALL	SMALL
Soils	MODERATE	SMALL	MODERATE
Seismic	NONE	NONE	NONE
Water Resources : Surface	NONE	NONE	NONE
Water Resources : Ground	SMALL	SMALL	SMALL
Ecological Resources : Vegetation	SMALL	SMALL	SMALL
Ecological Resources : Wildlife	SMALL	SMALL	SMALL
Ecological Resources : Aquatic	NONE	NONE	NONE
Noise	SMALL	SMALL	SMALL
Air Quality	MODERATE	SMALL	MODERATE
Historic and Cultural Resources	SMALL	SMALL	SMALL
Visual and Scenic Resources	MODERATE	MODERATE	MODERATE
Socioeconomics	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL
Public and Occupational Health	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL

4.13.4 Non-Radioactive Solid Waste

Non-radiological solid waste primarily resulting from the onsite fabrication of SNF Storage Systems is expected to be generated at the CISF. Approximately 3,200 SNF Storage Systems would be used at the CISF over 20 years. However, some the SNF Storage Systems would not be fabricated onsite, only assembled. Additional small volumes of non-radiological solid waste are expected to be generated during routine, normal operations and decommissioning.

All solid waste generated at the CISF during operations and decommissioning would be disposed of in a Municipal solid waste landfill.

4.13.5 Hazardous and Mixed Waste

Hazardous or mixed wastes are not expected to be generated during operations at the CISF.

4.13.6 Waste Management Cumulative Impacts

Small quantities of waste are anticipated and would be controlled, stored and disposed of in compliance with 10 CFR Part 20. The cumulative impacts are expected to be small.

4.14 Integrated Environmental Impacts

WCS plans to license and construct the CISF in eight separate phases. Capacity for storage of approximately 5,000 MTUs of SNF and associated reactor related GTCC waste is planned in each of the eight phases. After the eighth phase is completed, approximately 40,000 MTUs of SNF and associated reactor related GTCC waste may be stored at the CISF. WCS analyzed the cumulative impacts for storing 40,000 MTUs of SNF and associated reactor related GTCC waste.

The cumulative environmental impacts for constructing and operating the CISF for all eight phases were analyzed in Chapter 4 of the Environmental Report. During Phase 1 of the project, the impacts from constructing the Security and Administration Building, Cask Handling Building, rail side track, and storage pads were analyzed. The environmental impacts associated with constructing Phase 1 of the CISF are bounding because the seven subsequent phases do not require construction of the Security and Administration Building, Cask Handling Building, and rail side track. The impacts of the seven subsequent phases would only include constructing the storage pads.

The Environmental Report addresses cumulative impacts to physical, biological, economic, and social parameters. In addition, the ER identifies resource uses, monitoring, potential mitigation measures, unavoidable adverse environmental impacts, the interaction between short-term uses of the environment and long-term productivity, and irreversible and irretrievable commitments of resources. Integrated impacts are presented in Table 4-14-1 for areas in which there are anticipated changes related to other activities that may arise from single or multiple actions and may result in additive or interactive effects (e.g., WCS low-level radioactive waste disposal license, NEF facility).

For transportation, the analysis in Section 4.2 includes cumulative impacts from other nearby operations. There would be small integrated adverse impacts to ecological resources as the impacts from the proposed CISF would be restricted to the site, and the proposed CISF takes up a small percentage of the habitat surrounding the site, thereby not significantly altering the integrated impacts already existing from other local and regional activities. There would be small integrated noise impacts because noise from activities at the proposed CISF would not impact any sensitive offsite receptors. There would be no integrated adverse impacts to cultural or historic resources. For visual/scenic resources, the analysis in Section 4.9 includes cumulative impacts from other nearby operations. Public and occupation health cumulative impacts are discussed in Section 4.12 and waste management cumulative impacts are discussed in Section 4.13. The non-radiological integrated and environmental impacts are provided in Table 4.14-1.

WCS analyzed the incremental and cumulative radiological impacts associated with storing 5,000 MTUs of SNF during Phase 1. A separate analysis was also conducted to evaluate the cumulative radiological impacts associated with storing up to 40,000 MTUs. The results of the analysis are presented in Chapter 9, Section 9.4.1.2 and Tables 9-2, 9-4 and 9-5 of the WCS SAR. (NAC, 2015)

During construction of Phase 2, workers may be exposed to direct radiation from the SNF located on the Phase 1 storage pad. An analysis was performed to estimate the dose rate associated with storing 5,000 MTUs of SNF along the perimeter of Phase 1 Protected Area on workers constructing the next phase.

The ISFSI includes NAC vertical concrete casks (VCCs) that would provide some shielding from the HSMs to dose points where the VCCs are between the HSM array and the dose point. No credit is taken for VCCs. The neutron and gamma source terms are based on the maximum source term allowed under the Certificate of Compliance or specific license for the HSMs do not account for decay during storage at the originating site.

The analysis demonstrates that the dose rate approximately 600 ft from the center of Phase 1 was approximately 0.011 mSv/hr (1.1 mrem/hr). Thus, dose rates from the construction of Phase 2 after completion of Phase 1 would not be expected to exceed the dose rate limits of 0.02 mSv/hr (2 mrem/hr) for members of the general public at the perimeter of the Protected Area.

The anticipated dose rates during construction of Phases 3 through 8 are similar or less than those predicted to occur during construction of Phase 2, because the additional shielding provided by the loaded storage canisters and due to the increased distances from the loaded storage canisters and the storage pads under construction.

The results indicated that the maximum dose rates at the perimeter of the security zone in proximity of where the storage pads will be constructed during Phase 2 through Phase 8 are less than 0.02 mSv/hr (2 mrem/hr) as depicted in WCS SAR Chapter 9 Figures 9-1, 9-2 and 9-3. Accordingly, the analysis that was performed demonstrates that the interaction of workers that would be involved during the construction of Phase 2 through Phase 8 would not be exposed to direct radiation from SNF in storage at Phase 1 exceeding the 0.02 mSv/hr (2 mrem/hr) and 0.5 mSv/y (50 mrem/y) limit for members of the public, as specified in 10 CFR 20.1302(b)(2)(ii).The estimated dose rates around the perimeter of Phase are presented in Table 4.2-1.

Table 4.14-1 Integrated Impacts

	Construction	Operation	Integrated
Transportation	SMALL	SMALL	SMALL
Soils	MODERATE	SMALL	MODERATE
Seismic	NONE	NONE	NONE
Water Resources : Surface	NONE	NONE	NONE
Water Resources : Ground	SMALL	SMALL	SMALL
Ecological Resources : Vegetation	SMALL	SMALL	SMALL
Ecological Resources : Wildlife	SMALL	SMALL	SMALL
Ecological Resources : Aquatic	NONE	NONE	NONE
Noise	SMALL	SMALL	SMALL
Air Quality	MODERATE	SMALL	MODERATE
Historic and Cultural Resources	SMALL	SMALL	SMALL
Visual and Scenic Resources	MODERATE	MODERATE	MODERATE
Socioeconomics	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL
Public and Occupational Health	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL

.

Mace, R. (2001). Aquifers of West Texas: An Overview. *Aquifers of West Texas* . Texas Water Development Board Report 356, ed. R.E. Mace, W.F. Mullican III, and E.S. Angle, p. 1-16.

Martinez, S. (2015). Governor Martinez letter to U.S. Department of Energy. New Mexico: Dated April 10, 2015.

Massachusetts Institute of Technology. (2011). The Future of the Nuclear Fuel Cycle: An Interdisciplinary MIT Study.

Massey, M., & and Dunn, B. (2000). Survey for Active Lesser Praire-Chicken Leks: Spring 2000 Revised Report November 1, 2000, New Mexico Department of Game and Fish Project W-104-R-40.

McGowen, J. G. (1979). Depositional Framework of the Lower Dockum Group (Triassic) Texas Panhandle: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 97, 60 p.

Mehras, Steven J., Ralph E. Best, Steven B. Ross, Kenneth A. Buxton, Jeffery L. England, Paule E. McConnell, Lawrence M. Massaro, and. (2014). *Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites: Fuel Cycle Research & Development* . U.S. Department of Energy – Nuclear Fuels Storage and Transportation Planning Project: Washington, D.C.

Miller, J. F. (1973). Precipitation-Frequency Atlas of the Western United States, NOAA Atlas 2, National Weather Service. Silver Spring, Maryland.

Mooney, W.D. and L.W. Braile. (1989). The Seismic Structure of the Continental Crust and Upper Mantel of North America in The Geology of North America – An Overview: Volume A, Decade of North American Geology: Geological Society of America, Boulder, CO, p. 39-52.

Mullican, W. I. (1997). Playas and Recharge of the Ogallala Aquifer on the Southern High Plains of Texas-An Examination Using Numerical Techniques: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 242, p. 72.

NAC International, Inc. (2015) WCS Scoping Evaluation

NAS. (1999). (National Academy of Sciences). *Committee on Health Risks of Exposure to Radon. (BEIR VI).* Washington, DC: National Academies Press.

National Environmental Policy Act of 1969. (n.d.).

National Historic Preservation Act of 1966. (n.d.).

NON-PROPRIETARY REQUEST FOR SUPPLEMENTAL INFORMATION AND OBSERVATIONS

RSI 18.2

WCS discusses transportation in Sections 3.2 and 4.2 of the ER. In Section 3.2, WCS identifies (1) the connected environmental impacts of transporting the SNF from the shutdown decommissioned reactors; (2) the roads around the WCS CISF and rail lines to be used for SNF transportation near the WCS CISF; and (3) the proposed rail spur to the WCS CISF. In Section 4.2, WCS evaluates the transportation impacts from construction and operation, to scenic views, air quality, water quality, and noise, the radiological and non-radiological impacts of transporting SNF, and more. In neither section does WCS identify the existing levels of transportation on the local roads or rails to which the proposed action would affect, nor the existing levels of transportation associated with ongoing activities at the WCS CISF that are related to waste disposal and storage.

This information is needed to allow NRC staff compliance with 10 CFR 51.70(b).

WCS Response to RSI 18.2:

The requested information has been incorporated into the Environmental Report in Section 4.2.2. WCS evaluated the existing levels of transportation on roadways and the rail line in the vicinity of WCS and the cumulative impact with construction of the proposed CISF and future operation of the CISF. The employee numbers have been updated.

WCS Environmental Report Impact:

WCS has provided the requested information by updating the Environmental Report, Section 4.2.2, corrections are below.

4.2.2 Operational Impacts

Texas State Highway 176 provides direct access to the proposed CISF for personnel and for transporting materials and construction supplies to the CISF. Since this highway serves as a main east-west trucking thoroughfare for local industry, it is anticipated that SH 176 would be able to handle the small, incremental increase in capacity due to heavy-duty traffic increases. The existing dedicated turning lanes would help alleviate congestion that might otherwise occur from increased truck traffic.

~~The SIA states that the security workforce at the CISF would be approximately 30 security officers, distributed among three shifts per day. Thus, the maximum potential increase to traffic due to security workers is 60 round trips per day. This is a highly conservative estimate since all workers do not work on any given day. Security shift changes for site personnel are estimated to average 4 to 6 vehicles per shift change. The range of vehicles per shift change is based on 3 shifts per day, 7 days per week. This yields a total of 21 shift changes per week. Based on 7 shifts per employee per week, it would require approximately 30 employees to staff each position around the clock each week. The entire operational staff is 184 employees who work only day shifts, excluding weekends. Thus, the average positions on a given weekday shift would be 190 personnel (184 managers, supervisors, and craft, plus 6 security officers). Allowing for some routine absences (e.g.; sick time, vacation time and car-pooling), the average~~

~~number of vehicles per week day shift should be less than 160. The day shift (first shift) during the normal work week would generate more vehicles per shift change since some of these positions are not staffed around the clock, e.g., some administration positions. Swing and graveyard shifts as well as weekend shifts would have fewer vehicles per shift change than the average, since all staff positions would not routinely work during these off shifts. About half of the vehicles would likely travel west from the site onto New Mexico Highway 234, towards the city of Eunice, New Mexico; others would likely turn north onto New Mexico Highway 18 towards the city of Hobbs, New Mexico. Others would travel east on Texas State Highway 176 toward Andrews, TX. Car-pooling would be encouraged to minimize the impact to traffic due to operational workers.~~

The workforce at the CISF would be approximately 45 to 60 people, distributed among three shifts per day. Thus, the maximum potential increase to traffic due to the CISF workforce is 60 round trips per day. This is a highly conservative estimate since all workers do not work on any given day. Shift changes for CISF site personnel are estimated to average 15-20 vehicles per shift change. The range of vehicles per shift change is based on 3 shifts per day, 7 days per week. This yields a total of 21 shift changes per week.

At the current WCS facility (not including the proposed WCS CISF), the entire operational staff is approximately 185 employees who primarily work only day shifts Monday to Friday, with the exception of security personnel on nights and weekends. Thus, the average site population on a given weekday shift would be 185 personnel and 185 round trips per day. About half of the vehicles would likely travel west from the site onto New Mexico Highway 234, towards the city of Eunice, New Mexico; others would likely turn north onto New Mexico Highway 18 towards the city of Hobbs, New Mexico. Others would travel east on Texas State Highway 176 toward Andrews, TX. Car-pooling would be encouraged to minimize the impact to traffic due to operational workers.

The current traffic at WCS due to operational deliveries and waste removal is an average of 1800 shipments per year or approximately 35 shipments per week or five round trips per day. These deliveries and/or waste removal are non-radiological. It is anticipated that once the CISF is operational, estimated shipments and waste delivery would not increase since operational and waste needs would tie into existing needs at the current WCS facility. The number of waste deliveries for disposal in 2015 was 530, which is an average of two shipments per day for a Monday to Friday work week. Once the CISF is operational, this number should not be impacted by the CISF since deliveries to the CISF are expected to be made via rail. This makes the total deliveries to the current WCS facility six roundtrips per day.

The total anticipated roundtrips per day to WCS following the completion of CISF construction for employees and non-hazardous deliveries and waste removal is approximately 247 based on the 2015 records for WCS current operation and proposed needs for the CISF.

The maximum number of construction workers is 50 during the peak of the 30-month construction period. Thus the maximum potential increase to traffic due to construction workers is ~~100~~ 50 round trips per day. The maximum potential increase to traffic due to construction and deliveries is 100 round trips per day over the site preparation and major building construction period. This value is based on the estimated number of material deliveries and construction waste shipments during the 30-month period of each of the eight phases of site preparation and major construction per phase of the project. Work shifts would be implemented and car-pooling would be encouraged to minimize the impact to traffic due to construction workers in the site vicinity.

The primary route into WCS is Texas State Highway 176, which serves as a major east-west route connecting to New Mexico State Road 176 to the west and the city of Andrews, Texas, to the east. U.S. Route 385 and Ranch Road 181 are the main north-south routes in Andrews County. Both of these routes connect to Texas State Highway 176 east of WCS. The average daily traffic volume on the segment of Texas State Highway 176 west of the site to the state line was 2,700 vehicles per day in 2007 (TXDOT 2009). In 2004, the segment of New Mexico State Road 176 from the state line west toward New Mexico State Road 209 and the outskirts of Eunice had an average daily traffic volume of 2,250 vehicles per day (NMDOT 2009). The average daily traffic on Texas State Highway 176 was 3,000 vehicles per day to the east of the site approaching Ranch Road 181, and 2,700 vehicles per day from Ranch Road 181 approaching the city of Andrews, where it intersects U.S. Route 385. The average daily traffic volume on Ranch Road 181 was 650 vehicles per day north of Texas State Highway 176 and 1,150 south of 176 (TXDOT 2009). No significant new traffic burdens (e.g. schools, hospitals, major industrial facilities) have been added since these surveys.

A rail line services WCS from the west that connects to the Texas—New Mexico Railroad approximately 10 kilometers (6 miles) west of the site near Eunice, New Mexico. This line connects to the Union Pacific line in Monahan's, Texas (WCS 2007b:10). For the rail line that services WCS from the west, WCS recorded 160 shipments between 1/1/15 and 7/1/2016 for an average of 0.42shipments per day or 2.1 shipments per five day work week. The rail shipments received at WCS were radioactive waste and mixed waste.   The rail transportation impacts from the CISF are discussed in section 3.2 of this ER.

The closest commercial airport to WCS is the Lea County Regional Airport located in the city of Hobbs, New Mexico. This airport is operated by Lea County along with two general aviation facilities located adjacent to the cities of Jal and Lovington. There are two other general aviation airports in the region: the Andrews County Airport, owned and operated by Andrews County, and Gaines County Airport, owned and operated by Gaines County. The airport formerly operating in Eunice was closed in 2007 (NMDOT 2009). The construction and operation of the CISF will have no impact on the proximal airports due to most people visiting WCS use the Midland International Air and Space Port.

Based on the average daily traffic on nearby roadways ~~average~~, the temporary increase in vehicle flow associated with onsite operations would occur for periods of short duration during shift changes with little effect on anticipated transportation impacts to the surrounding area. Integrated transportation impacts are small.

Add References to Chapter 9 of the ER:

NMDOT (New Mexico Department of Transportation), 2009, New Mexico Traffic Flow Maps of Urban Areas (2004) AADT, accessed through
http://nmshtd.state.nm.us/photo_gal1eries/TrafficFlowMaps/
2004%20Traffic%20F1ow%20Maps/County/Traff2004County_LEA.pdf.

TXDOT (Texas Department of Transportation), 2009, TXDOT Statewide Planning Map, 2007 Average Annual Daily Traffic Counts, accessed through http://www.txdot.gov/apps/statewide_mapping/ StatewidePlanningMap.html, July 21.

WCS (Waste Control Specialists, LLC), 2207b, Socioeconomic Impacts of the Waste Control Specialists Proposed Low-Level Radioactive Waste Disposal Facility, Andrews County, Texas, Dallas, Texas, March 16.

4.2.1.2 Noise

The temporary increase in noise along Texas State Highway 176 due to construction vehicles, earthmoving equipment, and other construction machinery is not expected to impact nearby receptors substantially since existing truck traffic currently uses this roadway.

The CISF would be designed and constructed in manner that would minimize the quantity of radioactive wastes and contaminated equipment, and facilitate the removal of radioactive wastes and contaminated materials at the time the CISF is permanently decommissioned pursuant to 10 CFR 72.130, “Criteria for decommissioning”. At the time of license termination, the site would be released for unrestricted use in accordance with 10 CFR 20, Subpart E. The impact from noise at the time of decommissioning is expected to be less than during construction therefore, the impact from noise is expected to be small.

4.2.2 Operational Impacts

Texas State Highway 176 provides direct access to the proposed CISF for personnel and for transporting materials and construction supplies to the CISF. Since this highway serves as a main east-west trucking thoroughfare for local industry, it is anticipated that SH 176 would be able to handle the small, incremental increase in capacity due to heavy-duty traffic increases. The existing dedicated turning lanes would help alleviate congestion that might otherwise occur from increased truck traffic.

The workforce at the CISF would be approximately 45 to 60 people, distributed among three shifts per day. Thus, the maximum potential increase to traffic due to the CISF workforce is 60 round trips per day. This is a highly conservative estimate since all workers do not work on any given day. Shift changes for CISF site personnel are estimated to average 15-20 vehicles per shift change. The range of vehicles per shift change is based on 3 shifts per day, 7 days per week. This yields a total of 21 shift changes per week.

At the current WCS facility (not including the proposed WCS CISF), the entire operational staff is approximately 185 employees who primarily work only day shifts Monday to Friday, with the exception of security personnel on nights and weekends. Thus, the average site population on a given weekday shift would be 185 personnel and 185 round trips per day. About half of the vehicles would likely travel west from the site onto New Mexico Highway 234, towards the city of Eunice, New Mexico; others would likely turn north onto New Mexico Highway 18 towards the city of Hobbs, New Mexico. Others would travel east on Texas State Highway 176 toward Andrews, TX. Car-pooling would be encouraged to minimize the impact to traffic due to operational workers.

The current traffic at WCS due to operational deliveries and waste removal is an average of 1800 shipments per year or approximately 35 shipments per week or five round trips per day. These deliveries and/or waste removal are non-radiological. It is anticipated that once the CISF is operational, estimated shipments and waste delivery would not increase since operational and waste needs would tie into existing needs at the current WCS facility. The number of waste deliveries for disposal in 2015 was 530, which is an average of two shipments per day for a Monday to Friday work week. Once the CISF is operational, this number should not be impacted by the CISF since deliveries to the CISF are expected to be made via rail. This makes the total deliveries to the current WCS facility six roundtrips per day.

The total anticipated roundtrips per day to WCS following the completion of CISF construction for employees and non-hazardous deliveries and waste removal is approximately 247 based on the 2015 records for WCS current operation and proposed needs for the CISF.

The maximum number of construction workers is 50 during the peak of the 30-month construction period. Thus the maximum potential increase to traffic due to construction workers is 50 round trips per day. The maximum potential increase to traffic due to construction and deliveries is 100 round trips per day over the site preparation and major building construction period. This value is based on the estimated number of material deliveries and construction waste shipments during the 30-month period of each of the eight phases of site preparation and major construction per phase of the project. Work shifts would be implemented and car-pooling would be encouraged to minimize the impact to traffic due to construction workers in the site vicinity.

The primary route into WCS is Texas State Highway 176, which serves as a major east-west route connecting to New Mexico State Road 176 to the west and the city of Andrews, Texas, to the east. U.S. Route 385 and Ranch Road 181 are the main north-south routes in Andrews County. Both of these routes connect to Texas State Highway 176 east of WCS. The average daily traffic volume on the segment of Texas State Highway 176 west of the site to the state line was 2,700 vehicles per day in 2007 (TXDOT 2009). In 2004, the segment of New Mexico State Road 176 from the state line west toward New Mexico State Road 209 and the outskirts of Eunice had an average daily traffic volume of 2,250 vehicles per day (NMDOT 2009). The average daily traffic on Texas State Highway 176 was 3,000 vehicles per day to the east of the site approaching

Ranch Road 181, and 2,700 vehicles per day from Ranch Road 181 approaching the city of Andrews, where it intersects U.S. Route 385. The average daily traffic volume on Ranch Road 181 was 650 vehicles per day north of Texas State Highway 176 and 1,150 south of 176 (TXDOT 2009). No significant new traffic burdens (e.g. schools, hospitals, major industrial facilities) have been added since these surveys.

A rail line services WCS from the west that connects to the Texas—New Mexico Railroad approximately 10 kilometers (6 miles) west of the site near Eunice, New Mexico. This line connects to the Union Pacific line in Monahan's, Texas (WCS 2007b:10). For the rail line that services WCS from the west, WCS recorded 160 shipments between 1/1/15 and 7/1/2016 for an average of 0.42shipments per day or 2.1 shipments per five day work week. The rail shipments received at WCS were radioactive waste and mixed waste. The rail transportation impacts from the CISF are discussed in section 3.2 of this ER.

The closest commercial airport to WCS is the Lea County Regional Airport located in the city of Hobbs, New Mexico. This airport is operated by Lea County along with two general aviation facilities located adjacent to the cities of Jal and Lovington. There are two other general aviation airports in the region: the Andrews County Airport, owned and operated by Andrews County, and Gaines County Airport, owned and operated by Gaines County. The airport formerly operating in Eunice was closed in 2007 (NMDOT 2009). The construction and operation of the CISF will have no impact on the proximal airports due to most people visiting WCS use the Midland International Air and Space Port.

Based on the average daily traffic on nearby roadways, the temporary increase in vehicle flow associated with onsite operations would occur for periods of short duration during shift changes with little effect on anticipated transportation impacts to the surrounding area. Integrated transportation impacts are small.

National Research Council. (2006). *Committee on the Biological Effects of Ionizing Radiation, (BEIR VII)* . Washington, D.C: National Academies Press.

Nativ, R. and G.N. Gutierrez. (1988). Hydrochemistry of Cretaceous Aquifers, Texas Panhandle and Eastern New Mexico: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 88-3, p. 32.

Nativ, R. (1988). Hydrogeology and Hydrochemistry of the Ogallala Aquifer, Southern High Plains, Texas Panhandle and Eastern New Mexico: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 177, p. 64.

NBS. (1959). (National Bureau of Standards). *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure.* U.S. Department of Commerce. National Bureau of Standards Handbook 69.

NCI. (2012). (National Cancer Institute). *No Excuses Mortality Risk Found in Countries with Nuclear Facilities-Fact Sheet.* U.S. Department of Health and Human Services, National Institute of Health. Available at: http://dceg.cancer.gov/about/organization/programs-ebp/reb/fact-sheet-mortality-risk.

NCRP. (2009). (National Council on Radiation Protection and Measures). *Ionizing Radiation Exposure of the Population of the United States* . NCRP Report 160.

NEF. (2005). National Enrichment Facility. *URENCO Environmental Report* . Published in April 2005.

Nicholson, A., Jr., and A. Clebsch, Jr. (1961). Geology and Ground-Water Conditions in Southern Lea County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Ground-Water Report 6, Socorro, New Mexico, p. 123.

NMDCA. (2015). (New Mexico Department of Cultural Affairs). *New Mexico Cultural Resources Information System (NMCRIS). DCA Historic Preservation* . Available at: https://nmcris.dca.state.nm.us. Accessed on June 8, 2015.

NMDOT (New Mexico Department of Transportation), 2009, New Mexico Traffic Flow Maps of Urban Areas (2004) AADT, accessed through http://nmshtd.state.nm.us/photo_gal1eries/TrafficFlowMaps/ 2004%20Traffic%20F1ow%20Maps/County/Traff2004County_LEA.pdf.

NMSHPO. (2015). (New Mexico State Historic Preservation Office). *Consolidated Interim Spent Fuel Storage Facility* . (HPD log 101784). Dated August 12, 2015.

NOAA. (2004). (National Oceanic and Atmospheric Administration). *Annual Climatological Summary for Midland TX and Hobbs NM, Climate Data Online, National Centers for Environmental Information* . Ashville, NC.

TPWD. (2016). Retrieved March 3, 2016, from (Texas Parks and Wildlife Department). Annotated County Lists of Rare Species. Andrews County. (last revision 1/5/2015).: http://www.tpwd.state.tx.us/gis/ris/es/

TRAB. (2014). (Texas Radiation Advisory Board). Texas Commission on Environmental Quality Program Report. Report for September 19, 2014.

TRAGIS. (n.d.). *Transportation Routing Analysis GIS*. Retrieved from https://webTRAGIS.ornl.gov

TXDOT (Texas Department of Transportation), 2009, TXDOT Statewide Planning Map, 2007 Average Annual Daily Trafic Counts, accessed through http://www.txdot.gov/apps/statewide_mapping/ StatewidePlanningMap.html, July 21

UNSCEAR. (2008). (United Nations Scientific Committee on the Effects of Atomic Radiation). *Report Vol. 1 Sources of Ionizing Radiation. United Nations Scientific Committee on the Effects of Atomic Radiation. Report to the General Assembly, with Scientific Annexes* .

USDA. (2015). U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), Web Soil Survey Website Application (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx).

U.S. Environmental Protection Agency (USEPA) Western Ecology Division, Ecoregion of New Mexico 2006, ftp://ftp.epa.gov/wed/ecoregions/nm/nm_front.pdf

UNSCEAR. (2013). (United Nations Scientific Committee on the Effects of Atomic Radiation). *Sources, Effects, and Risks of Ionizing Radiation. Volume 1* . Report to the General Assembly, Scientific Annex A. .

USFWS. (2016a, January). (U.S. Fish & Wildlife Service). *Conserving the Nature of America* . Retrievec from U.S. Fish & Wildlife Service: http://www.fws.gov/.

USFWS. (2016b). (U.S. Fish and Wildlife Service). *Species by Project Area Report* . Retrieved from U.S. Fish and Wildlife Service: http://www.fws.gov/endangered/.

USGS. (1999). (U.S. Geological Survey). *Naturally Occuring Radioactive Materials (NORM) in Produced Water and Oil-Field Equipment-An Issue for the Energy Industry* . U.S. Geological Survey Fact Sheet 0142-99, Version 1.0. Septeember: Available at: http://neic.usgs.gov/.

Wald, M. L. (2014). Energy Department Told to Stop Collecting Nuclear Waste Fee. The New York Times, published on November 20, 2013, p. A20.

WCS (Waste Control Specialists, LLC), 2207b, Socioeconomic Impacts of the Waste Control Specialists Proposed Low-Level Radioactive Waste Disposal Facility, Andrews County, Texas, Dallas, Texas, March 16.

WCS. (2007). (Waste Control Specialists LLC). *Application for License to Authorize Near Surface Land Disposal of Low-Level Radioactive Waste* . Dated March 2007.

WCS. (2011). (Waste Control Specialists LLC). *Low-Level Radioactive Waste Disposal Facility Pre-Operational Environmental Monitoring Report* . Dated July 11, 2011.

WCS. (2013). (Waste Control Specialists LLC). *Semi-Annual/Annual Radiological Environmental Monitoring Plan Report for January to December 2012* . Andrews, TX: Dated March 28, 2013.

WCS. (2014). (Waste Control Specialists LLC). *All Facilities Annual/Semi-Annual Radiological Environmental Monitoring Report, January 1-December 31, 2013* . Andrews, TX: Dated March 28, 2014.

WCS. (2015). (Waste Control Specialists LLC). *All Facilities Annual/Semi-Annual Radiological Environmental Monitoring Report January 1-December 31, 3014* . Andrews, TX: Dated March 30, 2015.

Weiner, R. H. (2013). RADTRAN 6/RadCat 6 User Guide, SAND2013-8095. Sandia National Laboratories. Section 8. Albuquerque, NM.

Weiner, R. K. (2014). *RADTRAN 6 Technical Manual SAND2013-0780* . Albuquerque, NM: Sandia National Laboratories.

West, Chisum and W. Smith. (2003). House Research Organization Bill Analysis HB 1567. Dated April 22, 2003.

(Wichmann, 2003) Wichmann, Erich (2003): *Abschätzung positiver gesundheitlicher Auswirkungen durch den Einsatz von Partikelfiltern bei Dieselfahrzeugen in Deutschland.* Umweltbundesamt Berlin. Report 2352, insbesondere Seite 32 zu Mortalität (PDF; 610 kB).

WIPP. (2003). *Safety Analysis Report.* Dated January 24, 2003.

WRCC. (2015). (Western Regional Climate Center). Retreived from Western Regional Climate Center: www.wrcc.dri.edu.

Wright, W. (1979). Petroleum Geology of the Permian Basin: West Texas Geological Society Publication 79-71, 98 p.

Yancey, K. E. (2015, July 2). Nuclear plant value dispute likely headed to court. *Kewaunee County Star-News* .