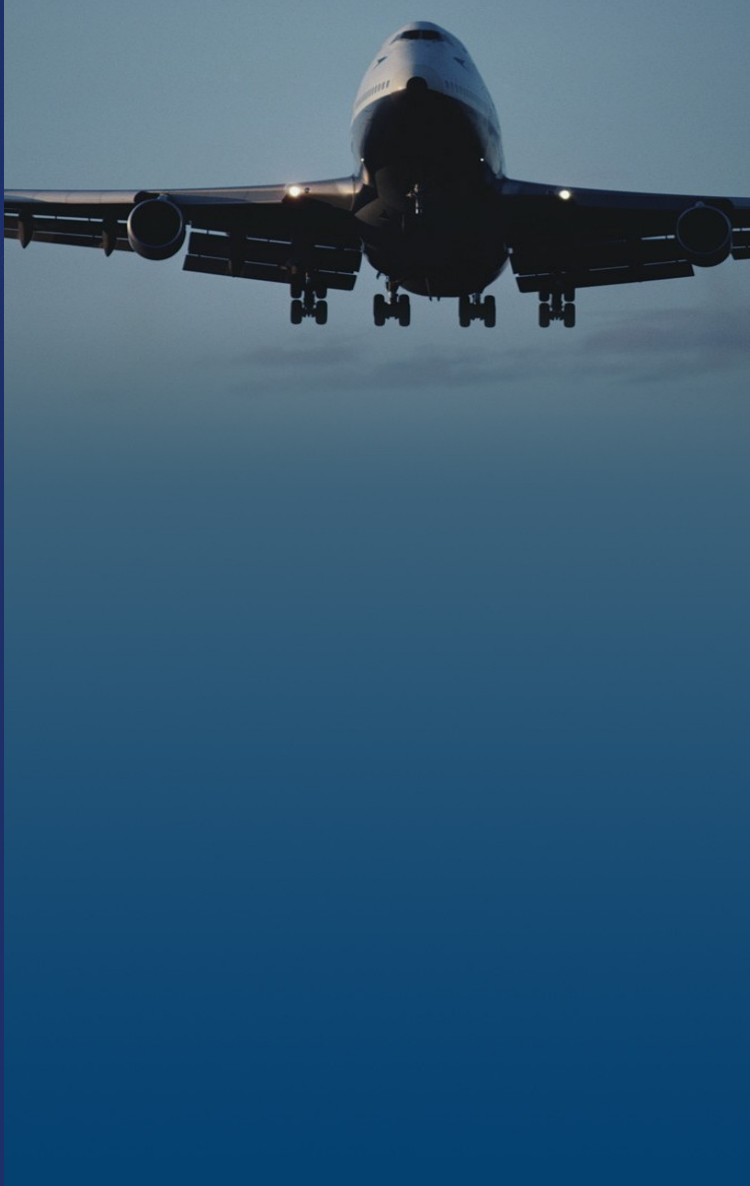
Federal Aviation Administration

Project Newark:
Goals, Objectives, and Simulations



Presentation to:
CAAC Team
October 22, 2010
Atlantic City, New Jersey, USA

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Presentation Overview

- Project Newark Basics
  - Partners
  - Initial Results
- Simulations
- Phase II Runway 29 Procedure Rework
- Summary

Project Newark

Newark Project Overview

Conduct an operational demonstration project using the satellite navigation technology of Local Area Augmentation.

- Partnership: The Port Authority of New York and New Jersey (PANYNJ), Continental Airlines, and Honeywell are establishing a Government Industry Partnership (GIP) with Navigation Service's Global Navigation Satellite Systems (GNSS) Program Office.

- A LAAS will be installed at Newark Airport to:
  - Demonstrate the improved performance and precision and interoperability with other GNSS capabilities.
  - Provide data to support FAA decisions on ground equipage and airline decisions on avionics.

GNSS Implementation Overview

GNSS Implementation

LAAS
- Newark
- Continental
- ATC
  - Approaches to RWY 29, RWYs 4/22 LR
  - Helicopter approaches, RNP

WAAS
- Teterboro
- Vertical Flight

2. Employ proven capability

- NY/NJ Airspace Initiative
  – Must solve pieces of puzzle simultaneously, not just one part

2. Employ proven capability

Memphis
- TAPS
- 4D approaches
- Time/Space merging
- NGATS Environment
  – Continuous descent approaches
- Air Traffic Control
- Closely spaced parallels
- RNP
- RNAV: Radius to Fix leg

1. Prove capability

FAATC Proving Ground

FAA Technical Center Demo Development and Proof of Concept for GNSS Applications

Vertical Flight
- Care Flite - SAAARs
- Helicopter LPVs
- Transition routes
- IFR infrastructure
- Helipads
- Public support
- Bell: Public VF criteria

Fixed Wing
- Allegiant
- Horizon
- American

Operations
Benefits
Procedures

Newark Project Partner Contributions

FAA

- Develop GLS Overlay Procedures
- Provide Data Collection Equipment
- Develop and Coordinate Prototype Terminal Procedures
- Collect Data and Analyze Performance
- Support GBAS Facility and Service Approval

Continental

- Equip 10 B-737NG Aircraft with LAAS Avionics (STC)
- Support FAA Data Collection Activities
- Apply for Special Approval for LAAS Cat I Operations
- Conduct Flight Test Operations
- Support Procedure Development and Simulation
- Complete Service Approval for Cat I Operations

PANYNJ

- Procure the Honeywell SLS-4000 LAAS
- Complete Site Preparation
- Install SLS-4000 System
- Provide Maintenance and Support
- Complete Facility Approval for Cat I Operations

Strategic Objectives

Demonstrate improved performance, precision, and interoperability with other SATNAV capabilities.

Identify and implement via ATC participation required RNAV/RNP operations to meet the performance based navigation that will support capacity and efficiency enhancements.

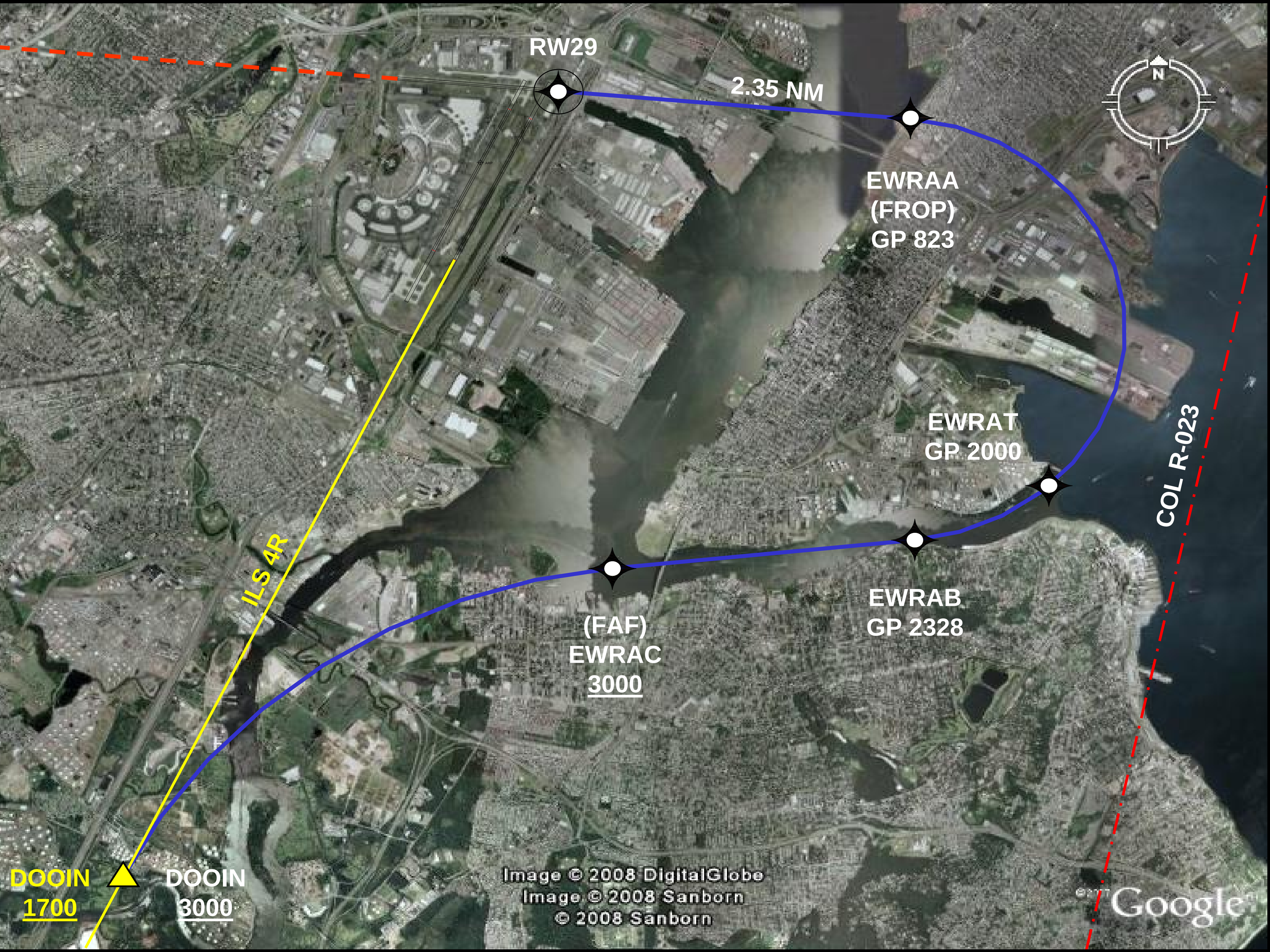
Incorporate ATC developed procedures and terminal applications to achieve increased capacity and efficiency.

Newark Project Core Team

- FAA Flight Standards
- Aviation System Standards
- FAA Eastern Region
- Eastern Flight Procedures Office
- Eastern Service Center
- New York Terminal Radar Approach Control (TRACON)
- Newark Air Traffic Control Tower (ATCT)
- Continental Airlines
- Boeing
- Honeywell
- FAA Engineering Development Services Navigation Team
- LAAS Operational Implementation Team (OIT)

Procedure Development Phases

- First phase
  - Developing and implement the straight-in approaches from the FAF using deviation guidance provided to the current cockpit instrumentations
  - Missed approach will be a straight ahead 4 NM runway heading with expected radar vectors
  - http://aeronav.faa.gov
- Second Phase
  - Focus on the curved approaches to Runways 29 and 22R
  - The team will examine what procedures, or ideas for procedures, and seek air traffic's feedback on the "pros and cons" of each piece of those procedures
  - Changes will be made to the procedures based on air traffic's inputs
  - Flight testing at ACY to determine technical feasibility and flyability using Terminal Area Paths (TAP)
  - Continental will also fly these procedures in their LAAS-capable simulator


RW29
2.35 NM
EWRAA
(FROP)
GP 823
EWRAT
GP 2000
COL R-023
EWRAB
GP 2328
(FAF)
EWRAC
3000
ILS 4R
DOOIN
1700
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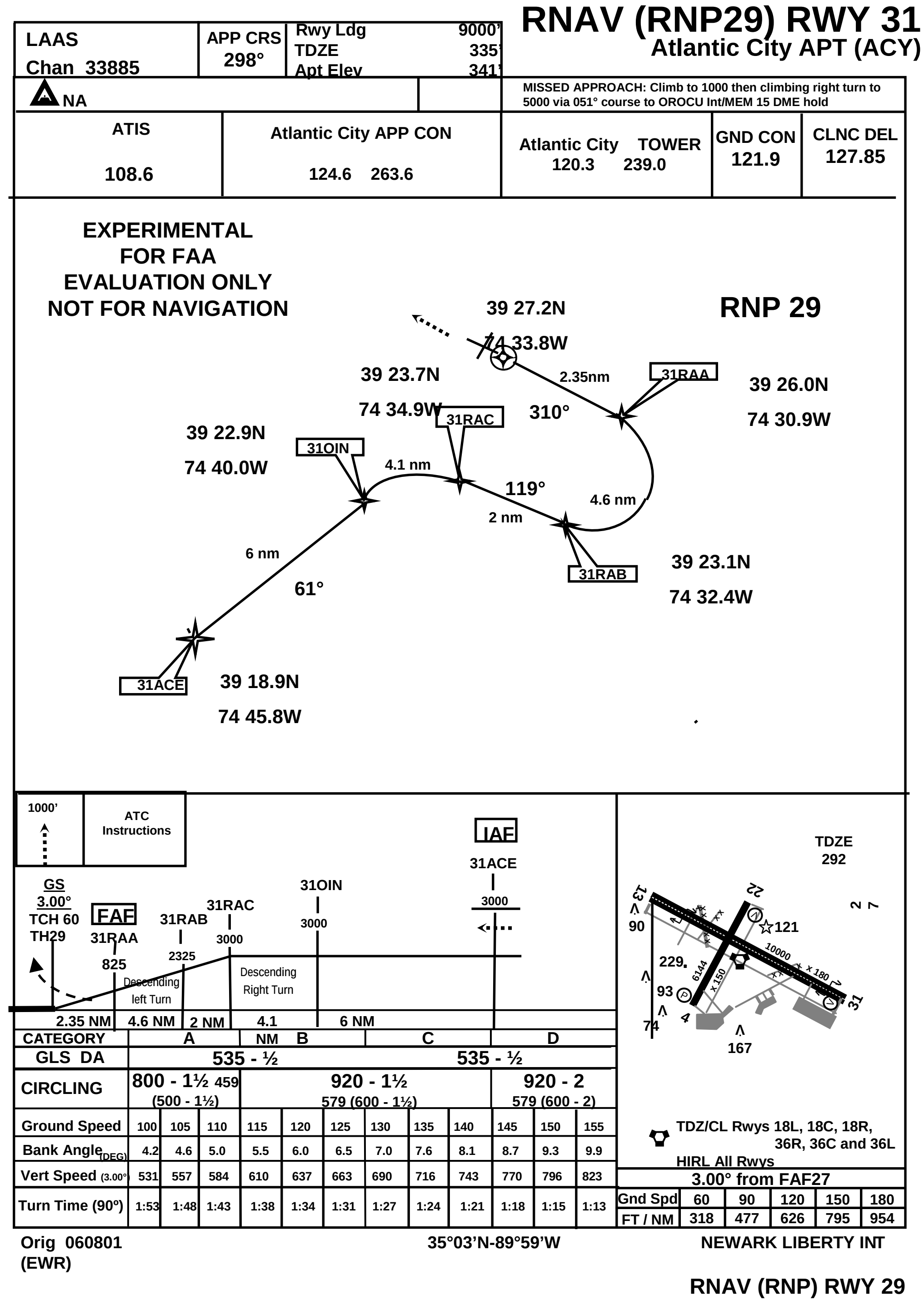
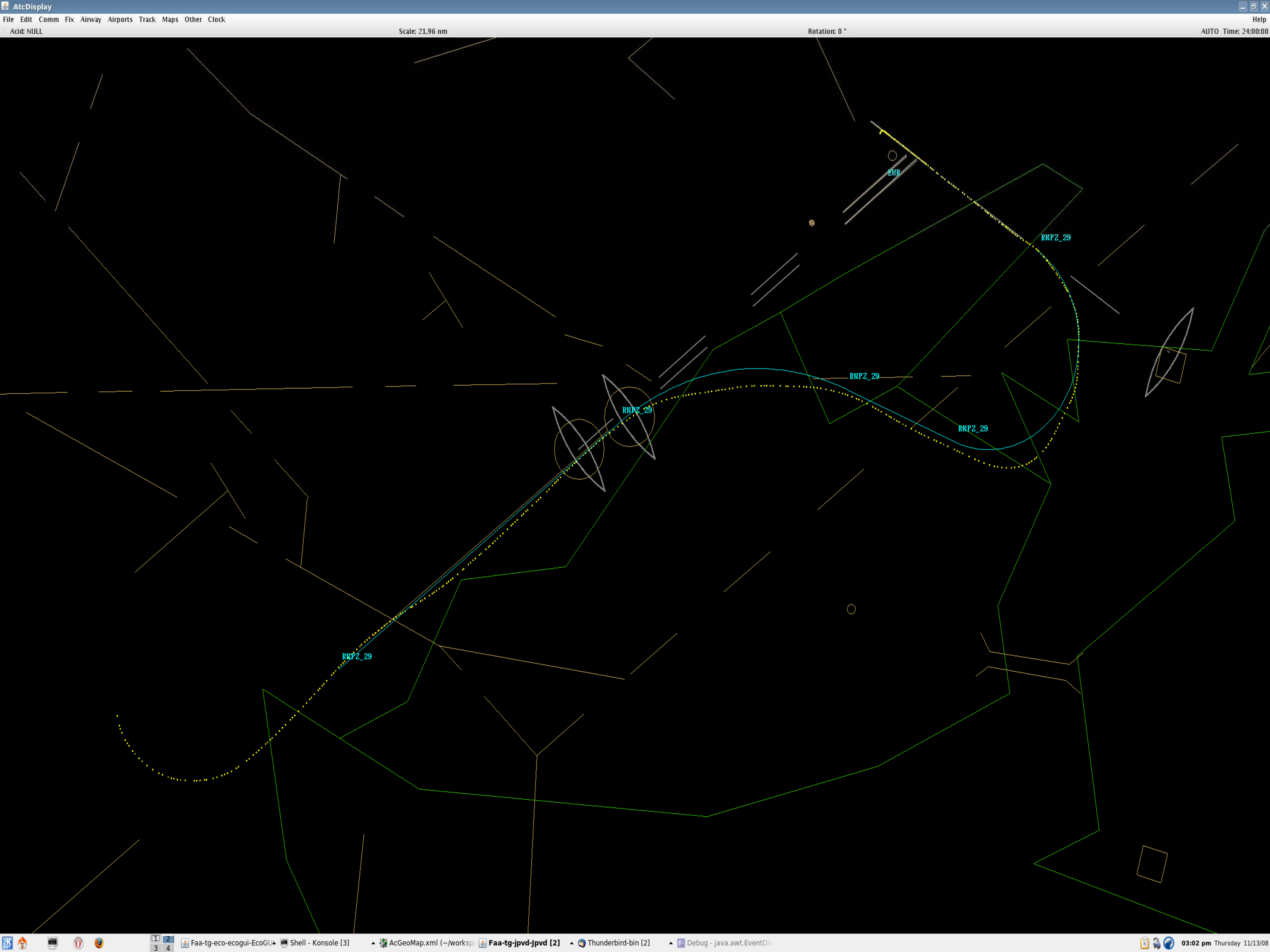
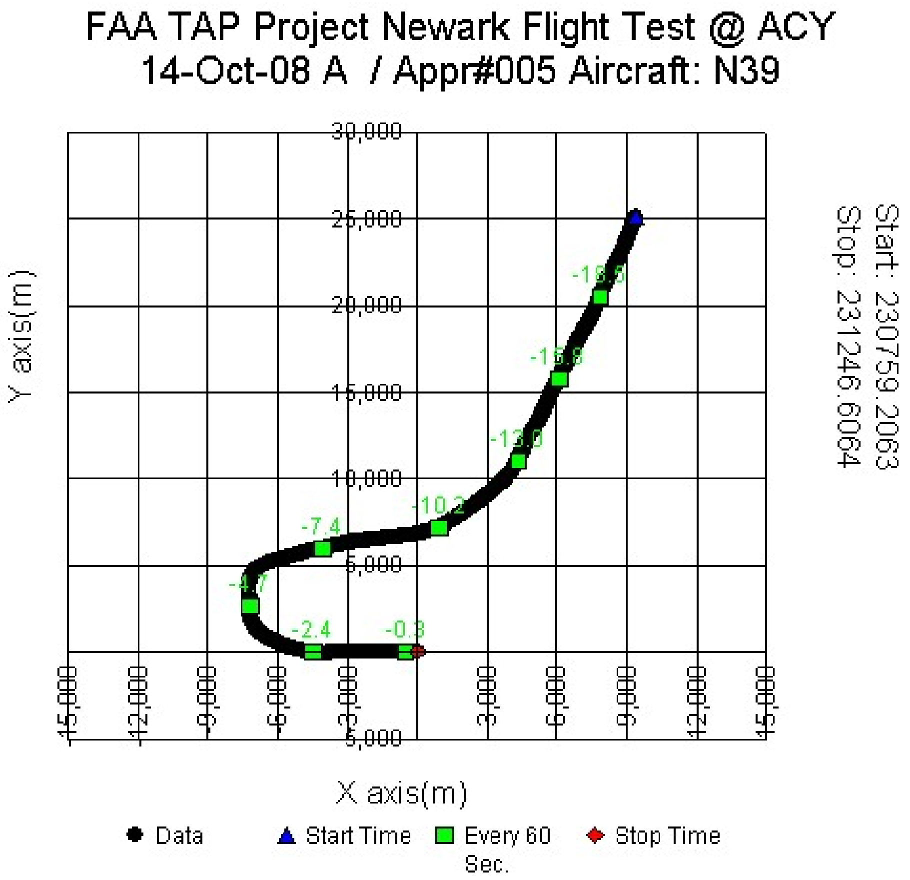
Atlantic City RNP Overlay

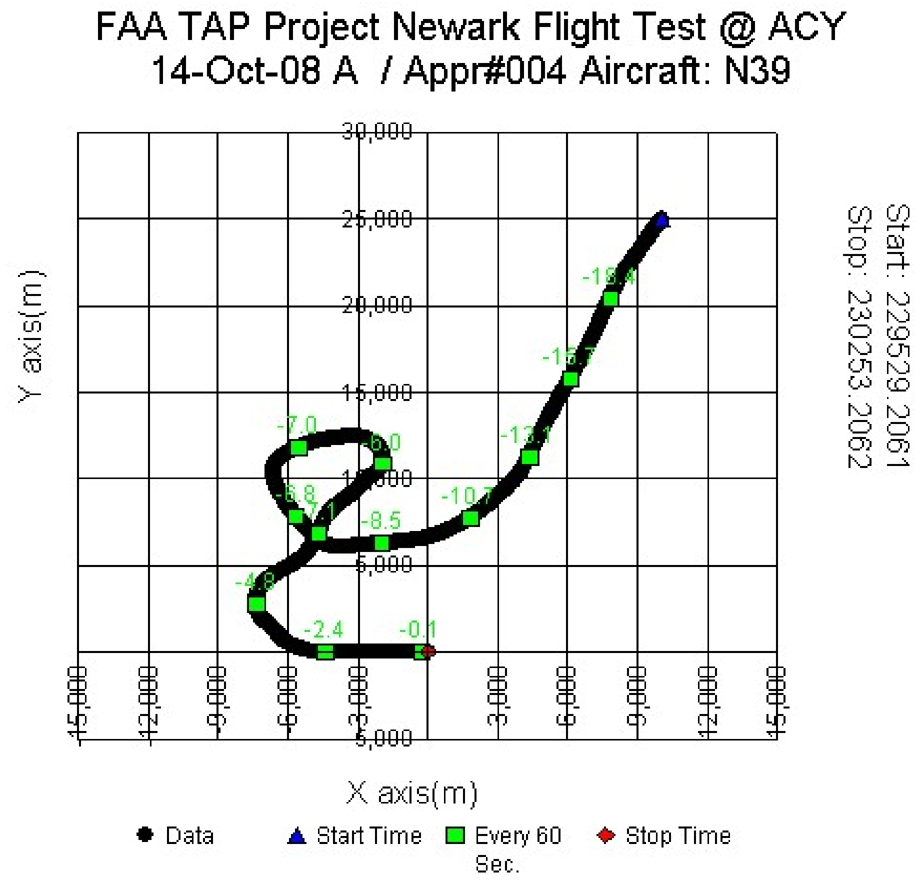
Newark RWY 29

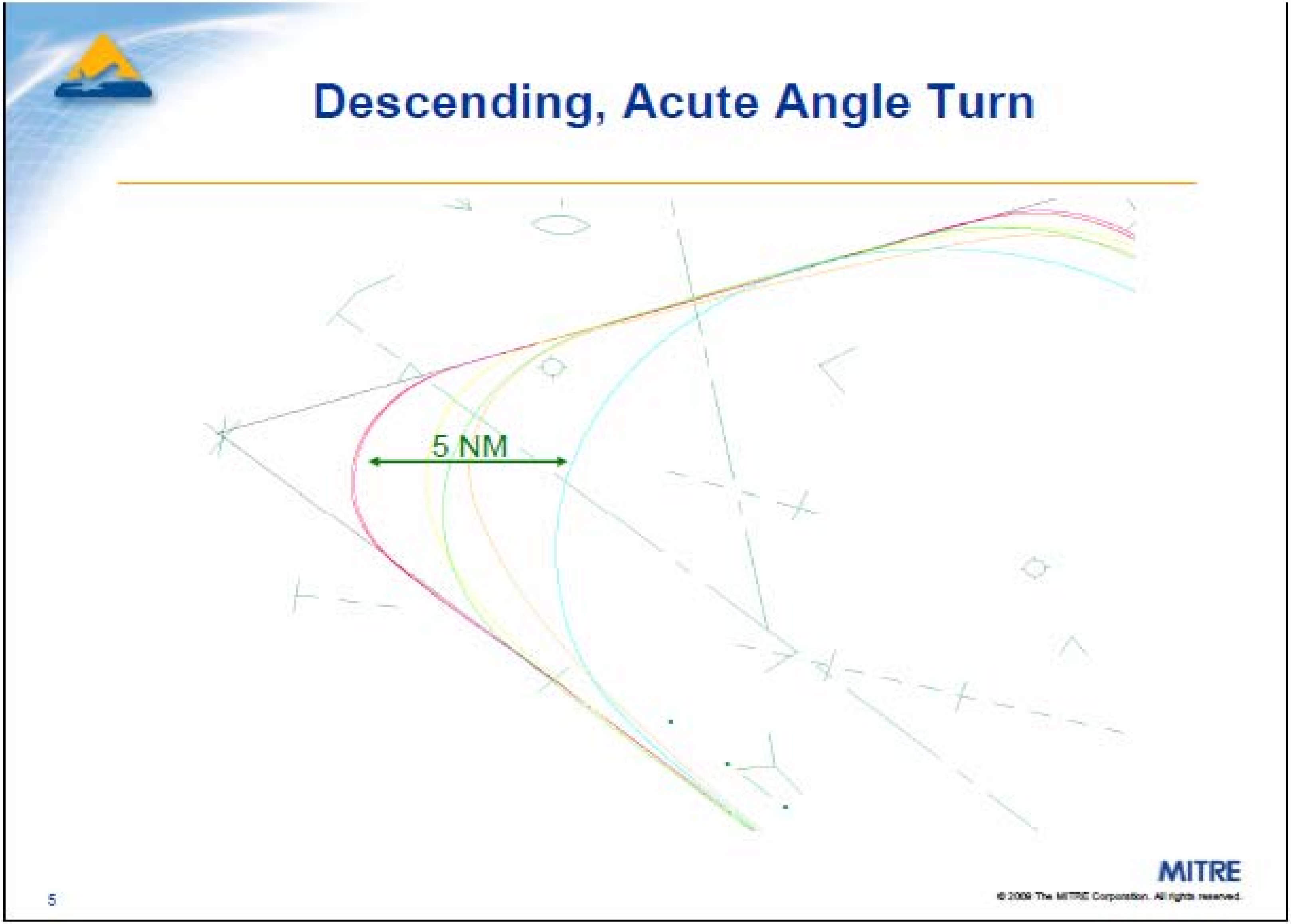



AtcDisplay
File Edit Comm Fix Airway Airports Track Maps Other Clock
Help
Acid: NULL
Scale: 21.96 nm
Rotation: 0 °
AUTO Time: 24:00:00
EWR
RNPZ_29
RNPZ_29
RNPZ_29
RNPZ_29
RNPZ_29
Shell - Konsole [3]
Faa-tg-jpvd-jpvd [2]
Thunderbird-bin [2]
03:02 pm Thursday 11/13/08

Initial Flight Test Results

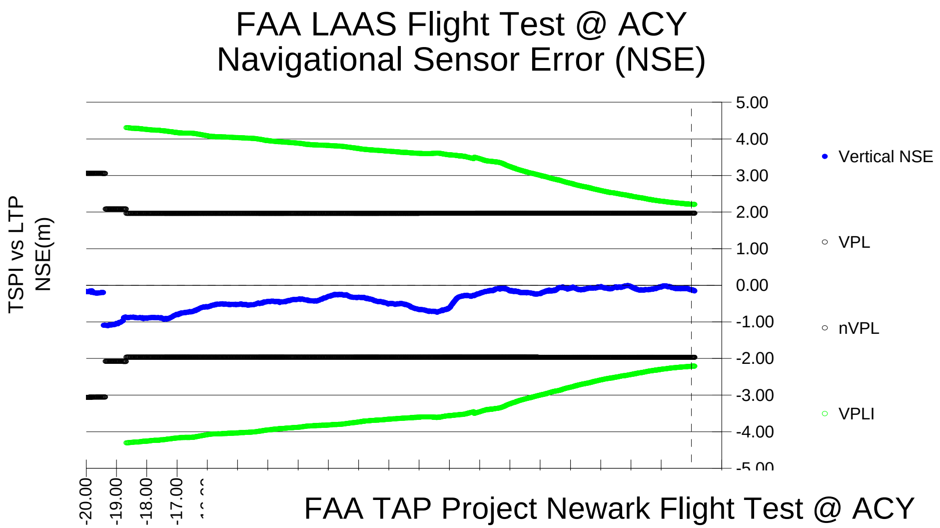


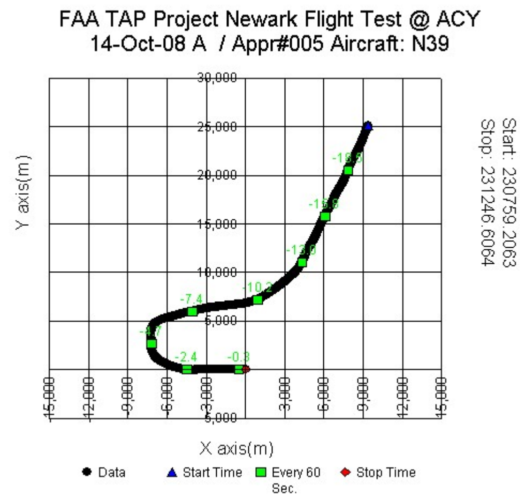


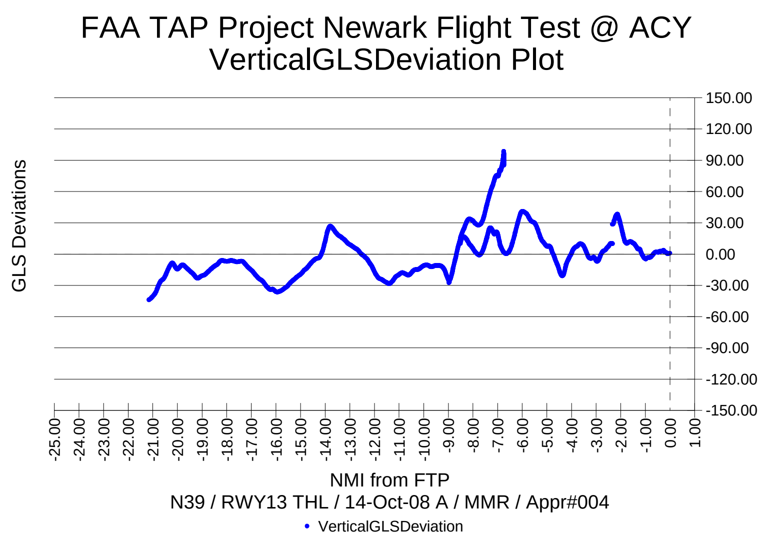


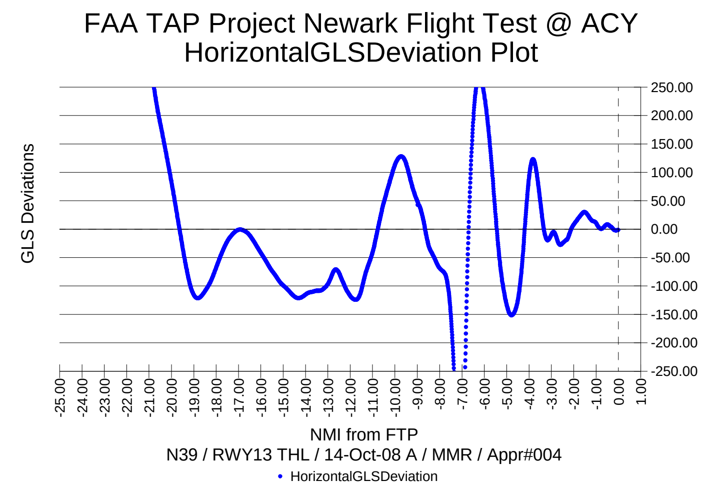
Variations are caused by bank angle limits in executing the turns (blue and green tracks). This is an example of difficulty in using fly-by turns in RNP (PBN) procedures as the airspace required is much larger than the corridor one would expect with RNP.

Navigation Team Analysis Products









Project Newark Phase II Simulation

- A two part simulation effort was identified:
  - The first step is to define scenario-based simulations to evaluate the benefit of new procedure to RWY29
    - Fast-time capacity study
    - ATC input is needed to ensure that the simulation quantifies realistic capacity improvement
  - Based on the successful outcome of the first step, Human-in-the-loop testing was planned
    - Evaluate tools to aid Air Traffic Control (ATC)
    - Determine ATC workload
    - Examine Missed Approach scenarios

Phase II – Modeling and Simulation Activities

***Phase II includes the conduct and analysis of a series of modeling and simulation (M&S) activities*:**

- **Fast-time – performed to examine system performance, including benefits assessment (e.g. delay, fuel burn, time/distance flown) & analysis of capacity, safety, risk, and efficiency**
- **Real-time, Human-in-the-loop (HITL) – performed to examine and demonstrate an end-to-end concept at a higher fidelity. Identify and assess specific human performance issues as a result of new air traffic management (ATM) activities**

M&S Activity	Modeling Tool/Facility
✓ Fast-Time Capacity Analysis – 1	Runway Delay Simulation Model (RDSIM)
✓ Real-Time Tower Feasibility Demonstration	Airport Facilities Terminal Integration (AFTIL)
Real-Time Tower Concept Refinement Demonstration	AFTIL
Fast-Time Capacity Analysis – 2	RDSIM
Real-Time Tower Concept Validation Simulation	AFTIL
Tower-TRACON Concept Validation Simulation	NextGen Integration and Evaluation Capability (NIEC)

Initial Simulation Activities

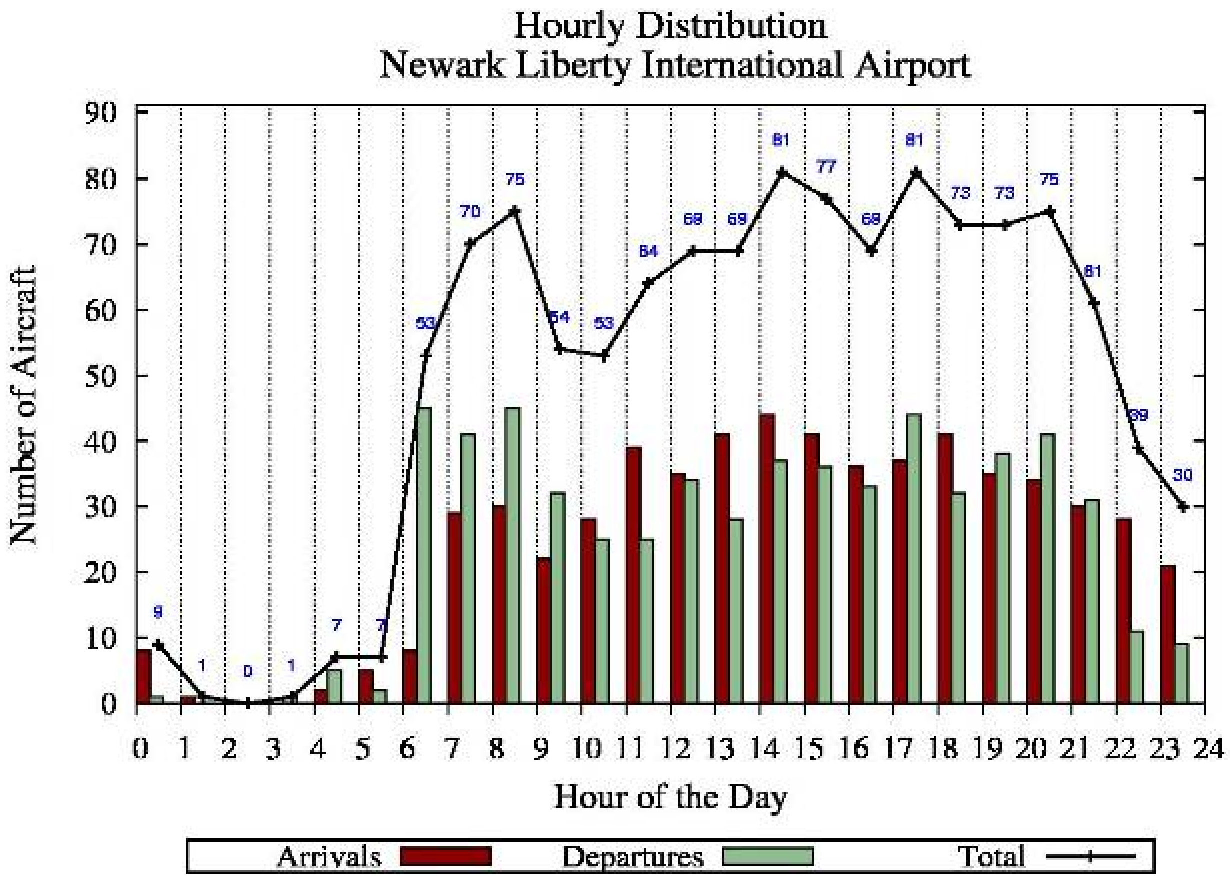
- Capacity Analysis Baseline
- Several baseline days were selected and analyzed
  - Traffic Flow, conditions, fleet mix
  - Data presented for April 12, 2010
    - VFR day using 4R for arrivals and 4L for departures
- VFR and IFR Results are presented for completeness, conditions under which RWY29 can be used will be addressed under operational constraints

Aircraft Mix

Air Carrier	Air Taxi	General Aviation	Total
768	399	24	1,191
64.48%	33.50%	2.02%	100.00%

Fleet Mix	
Aircraft	**Percentage**
1 – Heavy	8.66%
2 – B757	11.32%
3 – Large	79.16%
4 – Small +	0.26%
5 – Small-T	0.00%
6 - Small-S	0.60%

Traffic Distribution



Hour	Arrival	Departure	Total
00	8	1	9
01	1	0	1
02	0	0	0
03	0	1	1
04	2	5	7
05	5	2	7
06	8	45	53
07	29	41	70
08	30	45	75
09	22	32	54
10	28	25	53
11	39	25	64
12	35	34	69
13	41	28	69
14	44	37	81
15	41	36	77
16	36	33	69
17	37	44	81
18	41	32	73
19	35	38	73
20	34	41	75
21	30	31	61
22	28	11	39
23	21	9	30
Total	595	596	1191

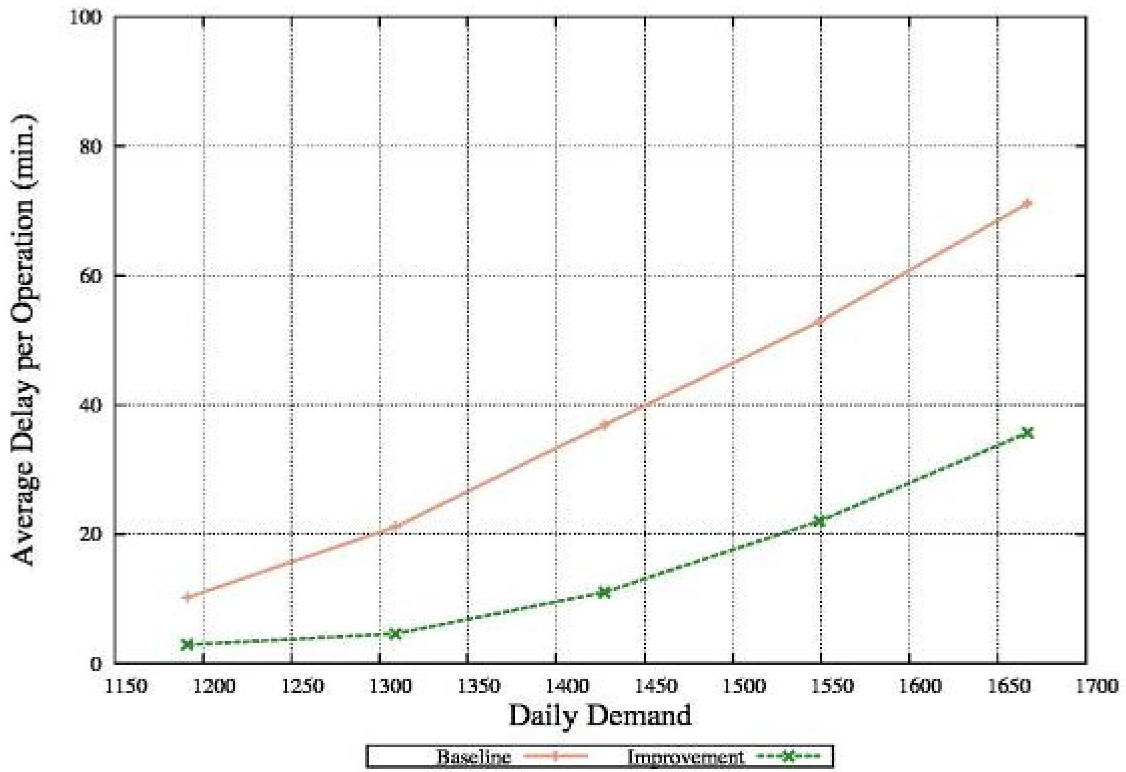
RNAV/RNP Approach to Runway 29

- Baseline
    - Arrive 4R Depart 4L
- Improvement
    - Arrive 4R & 29 Depart 4L
- Potential Benefit
    - Move 5-10 aircraft per hour from 4R to 29.
    - Addresses Non-homogenous mix
        - Potential aircraft for RW29 will be the small and smaller large

Separation Rules as Applied

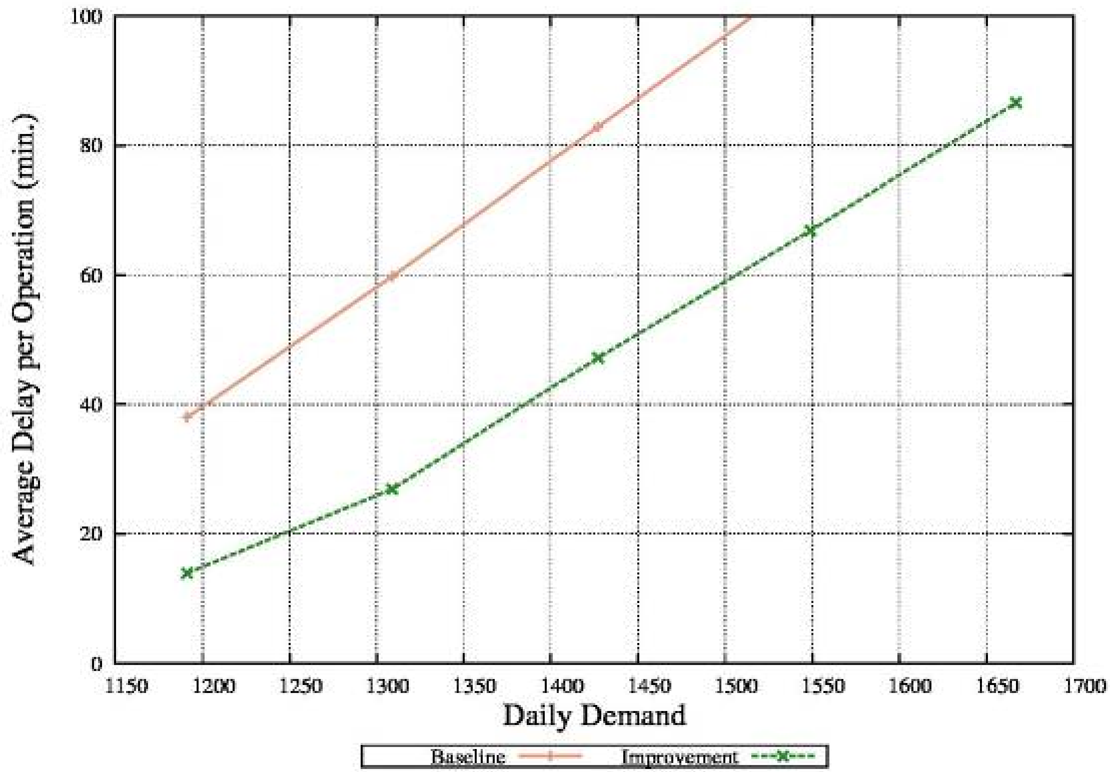
Lead	Lead Rwy	Trail	Trail Rwy	Separation
Arrival	29	Arrival	29	With GBAS providing a consistent flight path to a visual approach, it should be possible to reduce the minimum in trail separation to 15NM.
Arrival	4R	Arrival	29	Arrival on 4R must land and stop, exit or acknowledge prior to an arrival on 29 given clearance to land.
Arrival	29	Arrival	4R	Arrival on 29 must be through intersection prior to arrival on 4R reaching taxiway J.
Arrival	4R	Arrival	4R	5MIT, reduce to 2.5MIT based on runway occupancy times
Arrival	4R	Depart	4L	In IFR these runways act as a single runway. In VFR, these runways are independent.
Depart	4L	Arrival	4R	In IFR these runways act as a single runway. In VFR, these runways are independent.
Arrival	29	Depart	4L	Arrival on 29 must be clear of intersection prior to 4L depart roll
Depart	4L	Arrival	29	Departure must be airborne and through the intersection prior to arrival crossing threshold.

VFR – Daily Delay Estimates



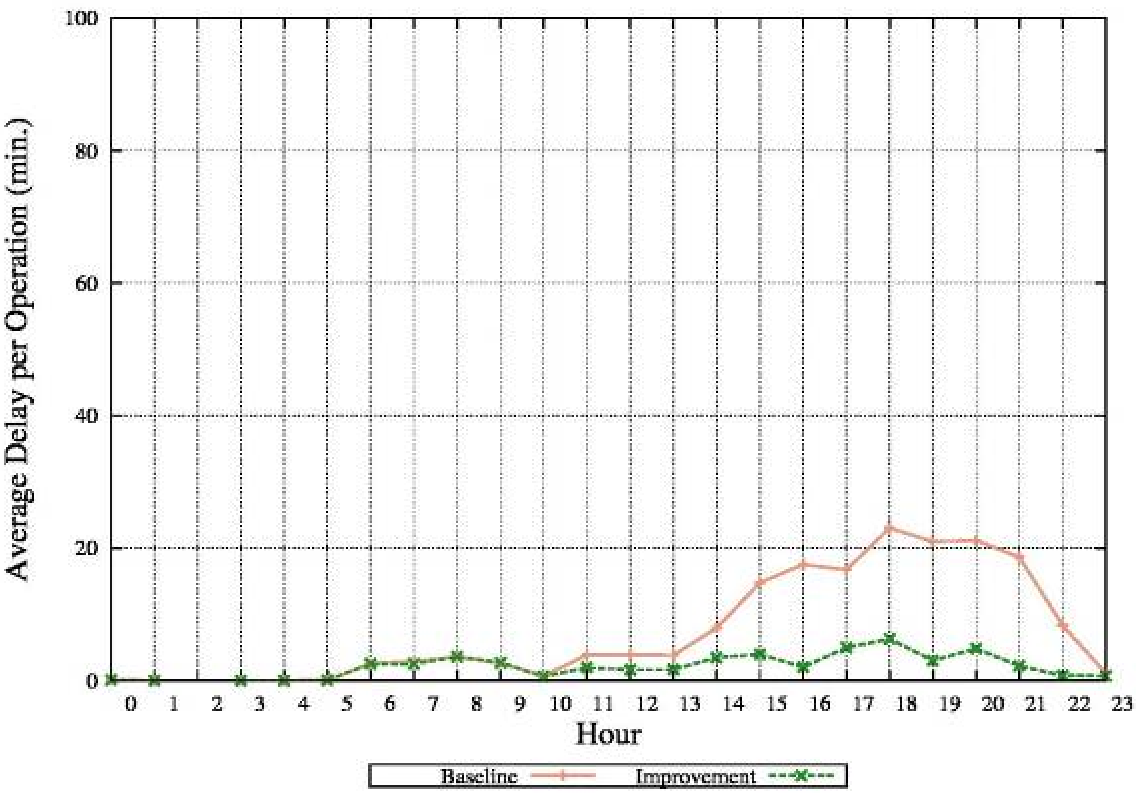
			Avg. Delay/ Operation (mins.)	
Weighted Daily Demand	Equivalent Days	Annual Operations	Baseline	Improvement
1,191	331	394,221	10.2	2.9
1,309	331	433,279	21.1	4.6
1,427	331	472,337	36.9	11.0
1,549	331	512,719	52.9	22.0
1,667	331	551,777	71.2	35.7

IFR – Daily Delay Estimates



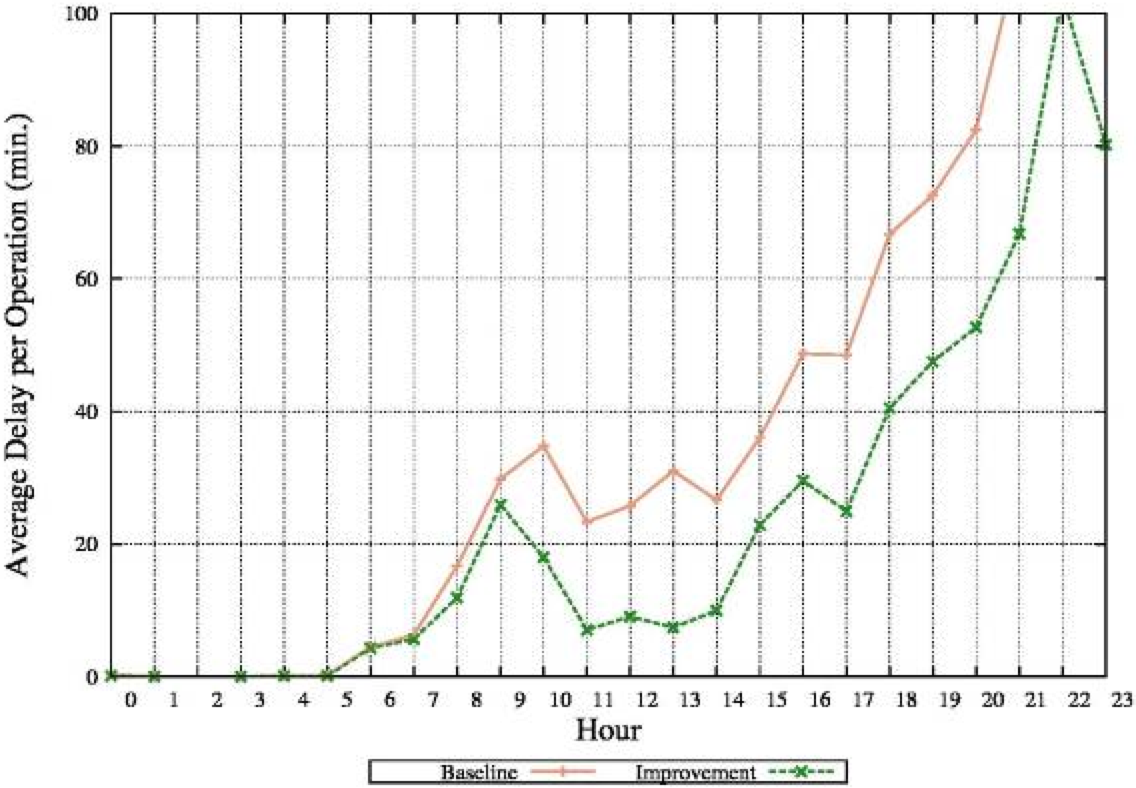
			Avg. Delay/ Operation (mins.)	
Weighted Daily Demand	Equivalent Days	Annual Operations	Baseline	Improvement
1,191	331	394,221	38.0	13.9
1,309	331	433,279	59.8	26.9
1,427	331	472,337	82.9	47.2
1,549	331	512,719	106.4	66.9
1,667	331	551,777	129.1	86.6

VFR – Hourly Delay Estimates



Hour	Demand	Average Delay Per Operation (min.) Baseline	Average Delay Per Operation (min.) Improvement
0	9	0.1	0.1
1	1	0.0	0.0
2	0	0.0	0.0
3	1	0.0	0.0
4	7	0.0	0.0
5	7	0.1	0.0
6	53	2.6	2.6
7	70	2.9	2.6
8	75	3.6	3.6
9	54	2.6	2.7
10	53	0.7	0.6
11	64	3.8	2.0
12	69	3.9	1.6
13	69	3.8	1.7
14	81	7.9	3.5
15	77	14.8	4.0
16	69	17.5	2.0
17	81	16.7	5.0
18	73	23.0	6.3
19	73	21.0	3.0
20	75	21.2	4.8
21	61	18.6	2.2
22	39	8.3	0.7
23	30	1.1	0.7

IFR – Hourly Delay Estimates



Hour	Demand	Average Delay Per Operation (min.) Baseline	Average Delay Per Operation (min.) Improvement
0	9	0.3	0.1
1	1	0.0	0.0
2	0	0.0	0.0
3	1	0.0	0.0
4	7	0.1	0.1
5	7	0.2	0.1
6	53	4.4	4.3
7	70	6.3	5.6
8	75	16.7	11.9
9	54	29.8	25.9
10	53	34.8	18.0
11	64	23.3	7.1
12	69	25.8	9.1
13	69	31.0	7.4
14	81	26.7	10.0
15	77	36.1	22.9
16	69	48.6	29.6
17	81	48.4	24.9
18	73	66.7	40.5
19	73	72.6	47.5
20	75	82.5	52.7
21	61	109.8	66.8
22	39	186.6	102.8
23	30	256.4	80.2

Initial Simulation Result/ Next Steps

- Providing access to RWY 29 via a generic path was shown to reduce airport delay
  - Perhaps an obvious result, but now it is verified
- Next Steps:
  - Refine the RWY 29 approach path so that it fits within the existing airspace
    - Agree on the right operational constraints
    - Identify which separation standards will be used
  - Determine the workload impact
    - Identify tools to assist with RWY29 traffic
    - Missed Approach is the largest concern for ATC

Planned Airport Facilities Terminal Integration Laboratory (AFTIL) Simulation

- The AFTIL being used for Project Newark testing.
- To help with the previous “spacing tool” discussion, the AFTIL will be configured exactly as the EWR Tower with the addition of several spacing tools:
  - Converging Runway Display Aid (CRDA)
  - Go-Around Spacing Tool
  - Arrival/Arrival or Arrival/Departure Windows
- RWY29 scenarios can be demonstrated first in the AFTIL for initial hands-on feasibility studies

Project Newark Phase II Simulations

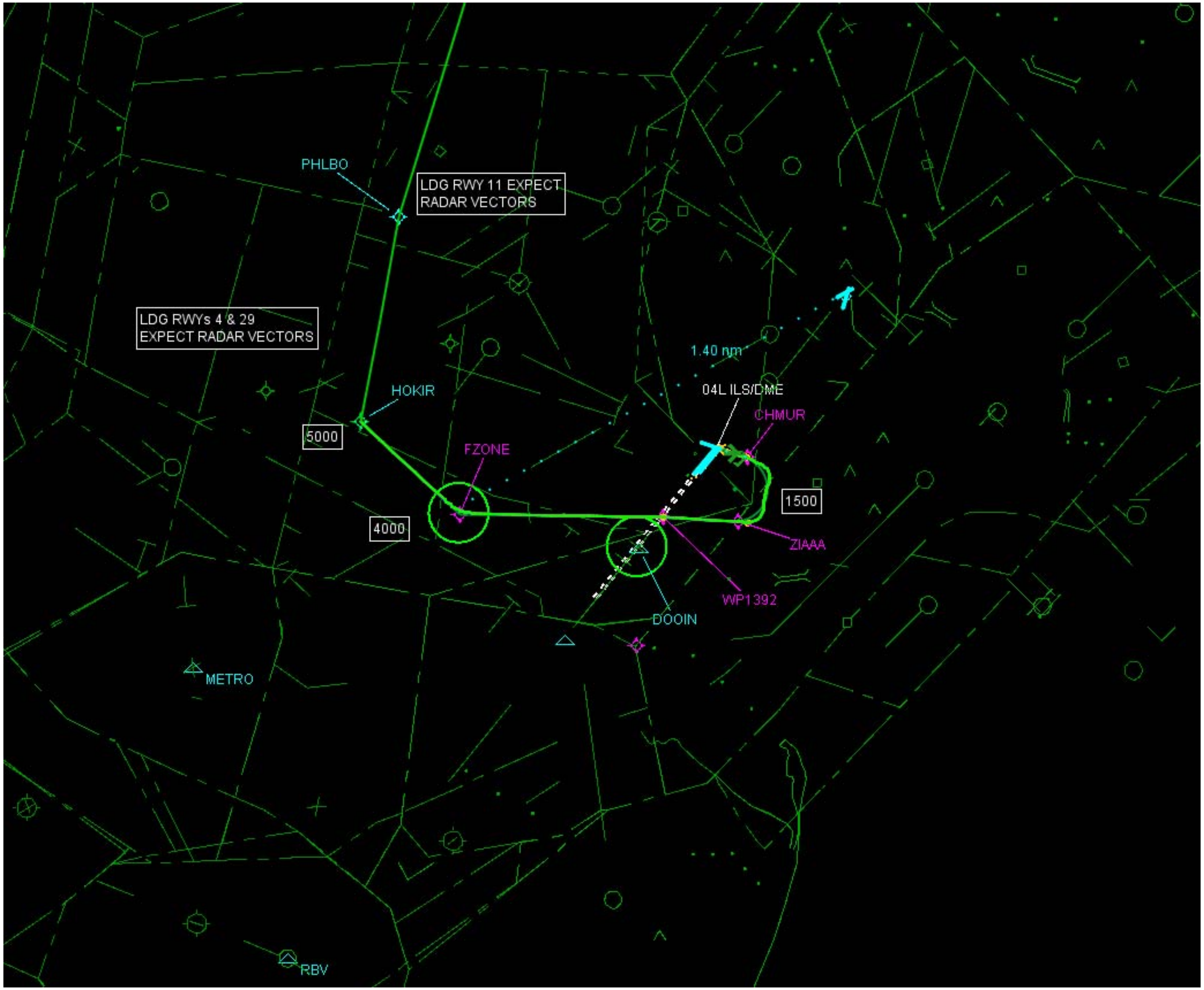
Project Newark Phase II Simulations

- Result of the simulation:
  - Getting the TRACON and the Tower to work the problem together in a controlled environment
  - Tools were useful
    - List of revisions were collected
    - Actions for the TRACON to define airspace needs
  - Next simulations planned for Feb 2011
  - Detailed test plan available

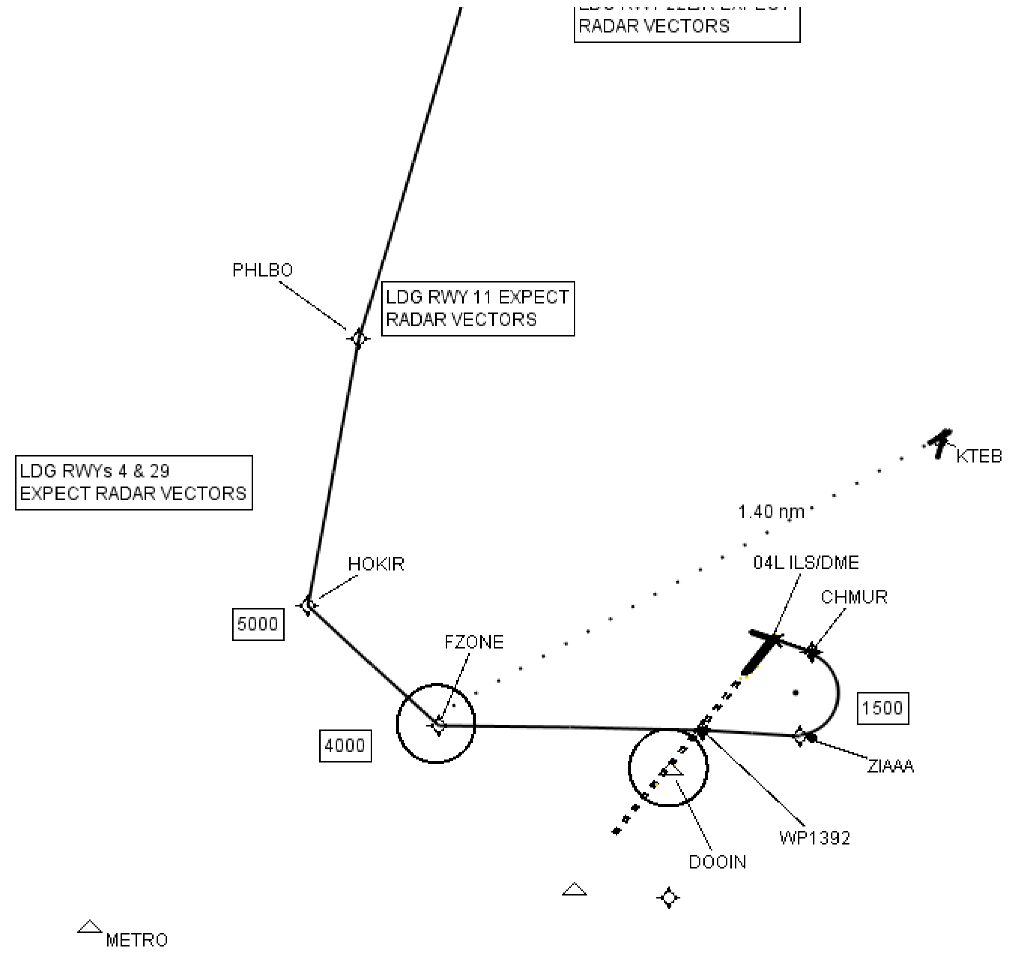
Phase II Changes to RWY29 RNP

- Discuss changes to the RWY29 procedure
  - Ground track
  - Leg types used
  - Desired time to complete procedure
    - Design speed and distance
- Review of recent flight testing

KEWR RNAV (RNP) Z RWY 29 (VIA RWY 4R)
Oct 30, 2008 Targets Package

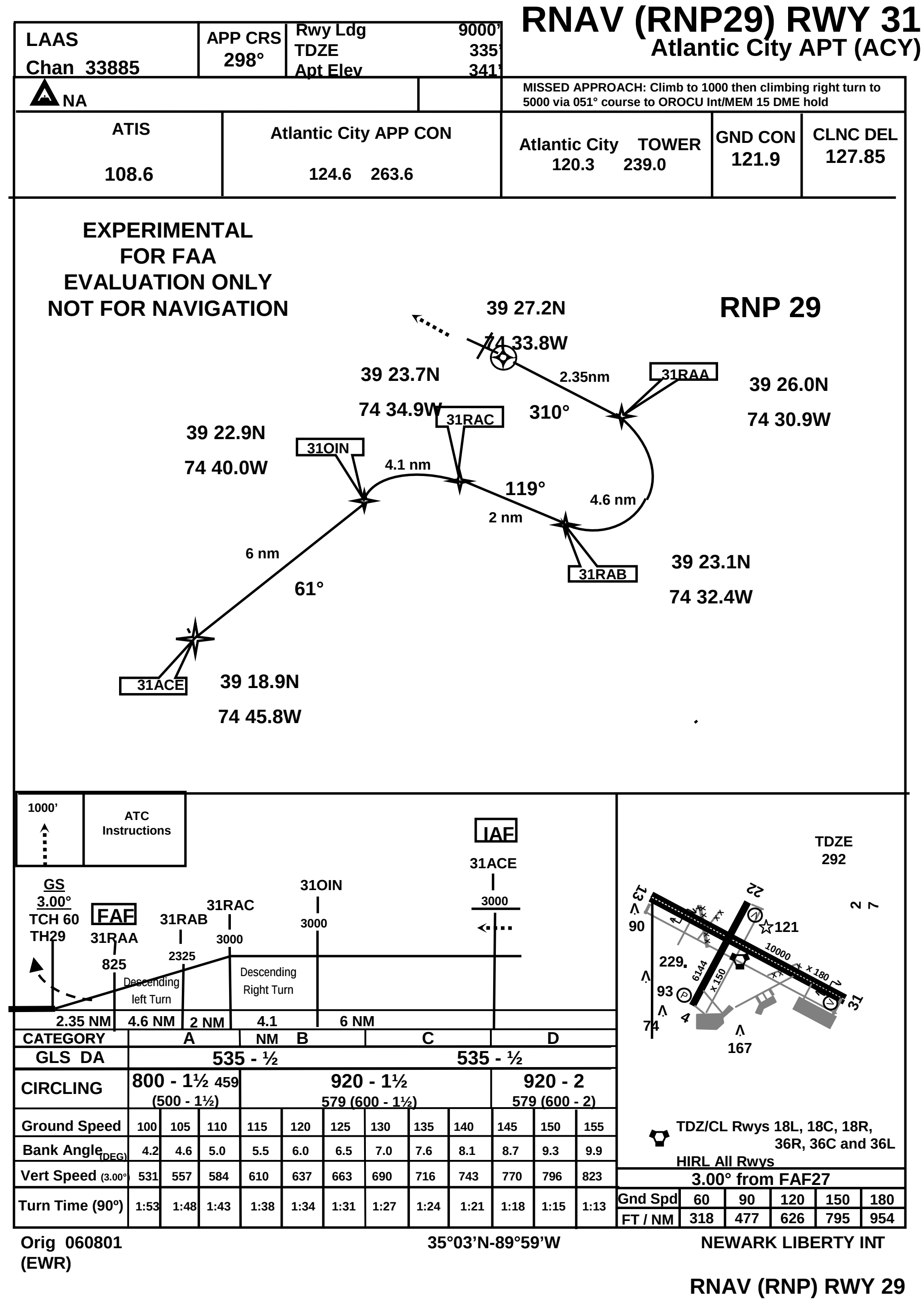


KEWR RNAV (RNP) Z RWY 29 (VIA RWY 4R)



Atlantic City RNP Overlay

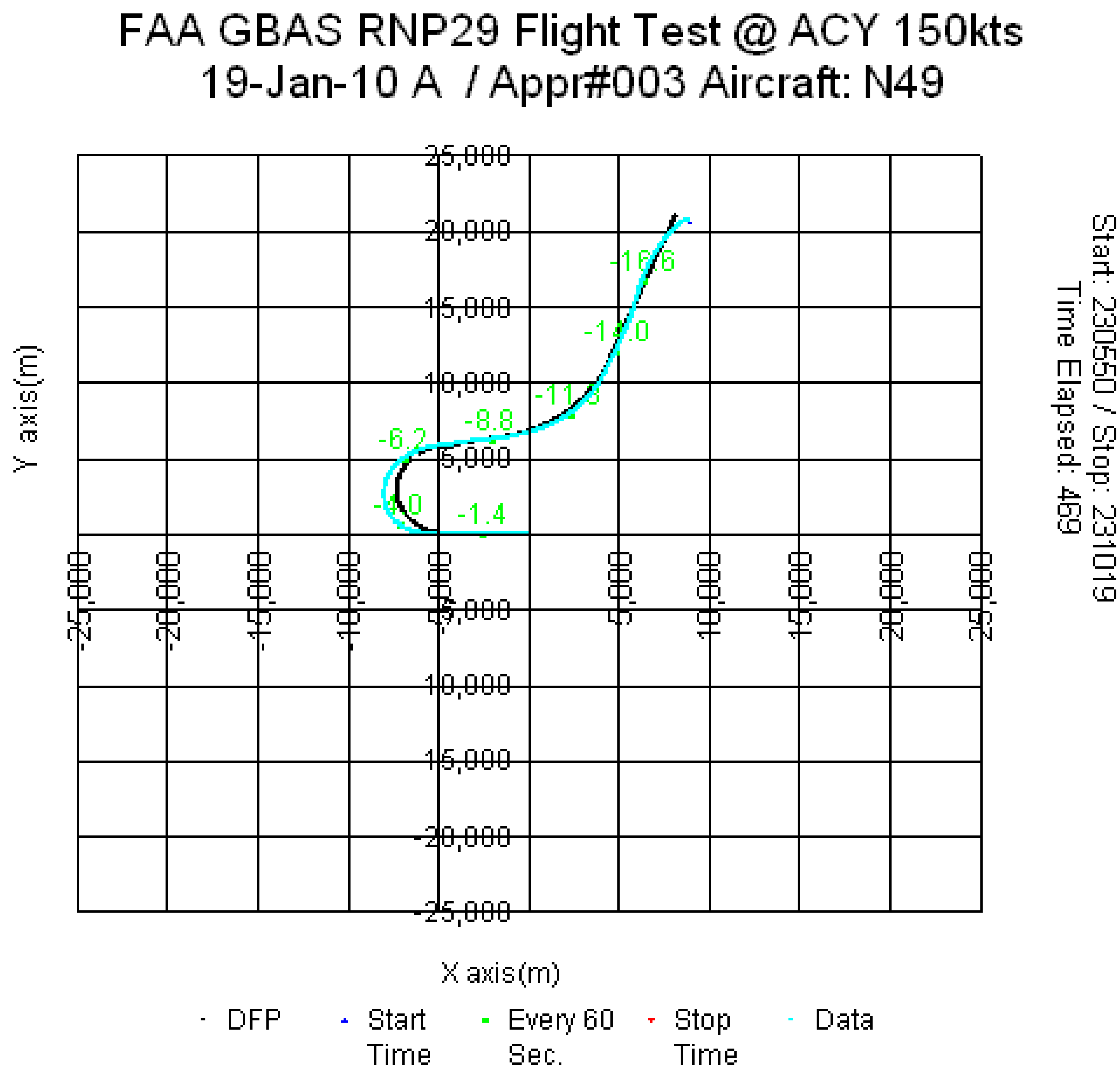
Newark RWY 29



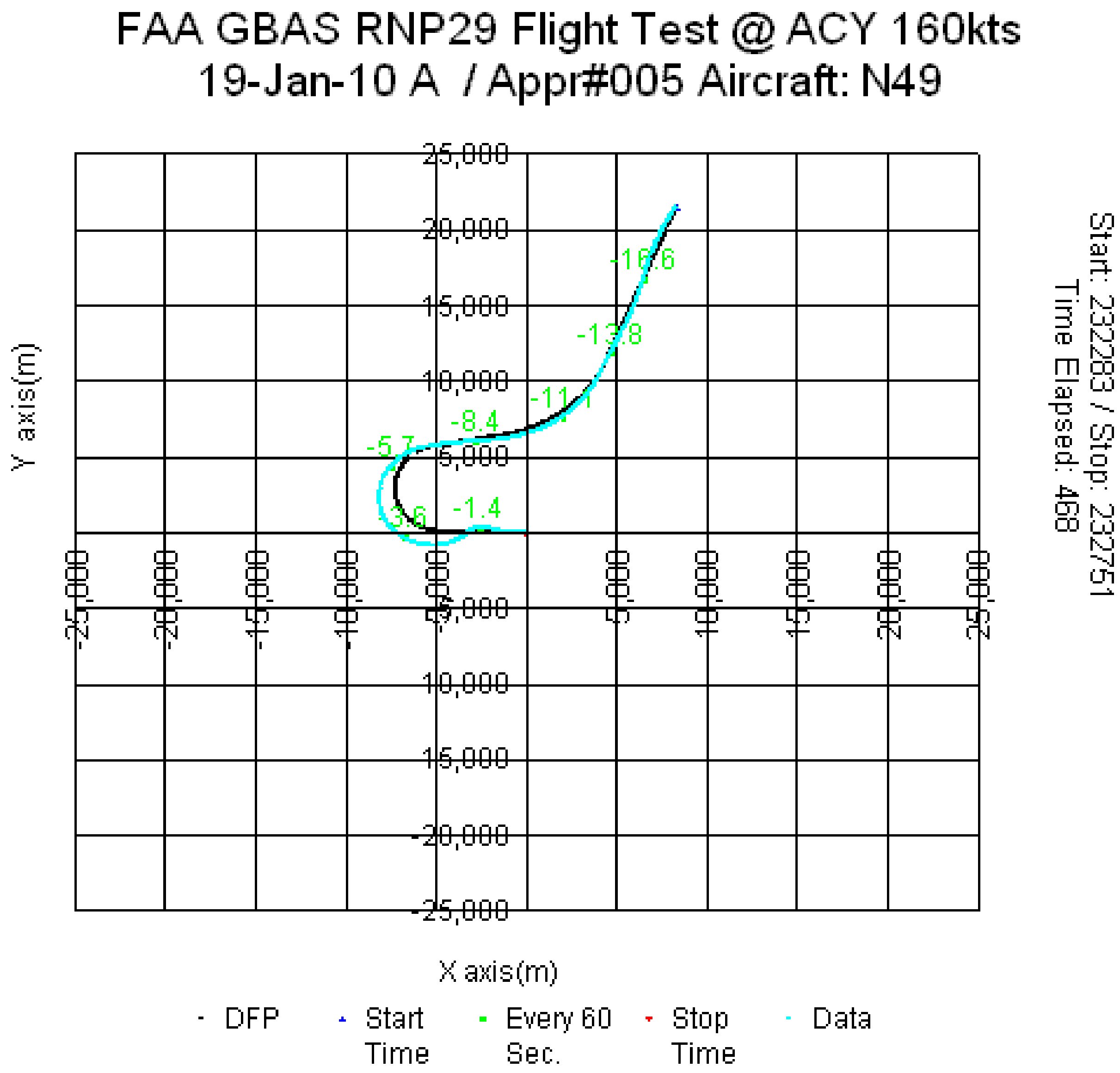
Expected Performance

- In previous analysis, we asked the subject pilots, FAA crew, to focus on minimizing Flight Technical Error (FTE) during manual flight
- We ended up with a wide variation in the procedure speed, and inconsistent FTE
- For current testing, the procedure speed were defined, and TAP tests were conducted using the ILS autopilot
  - Performance can be predicted based on the speed, turn radius, and bank angle limit of the navigator

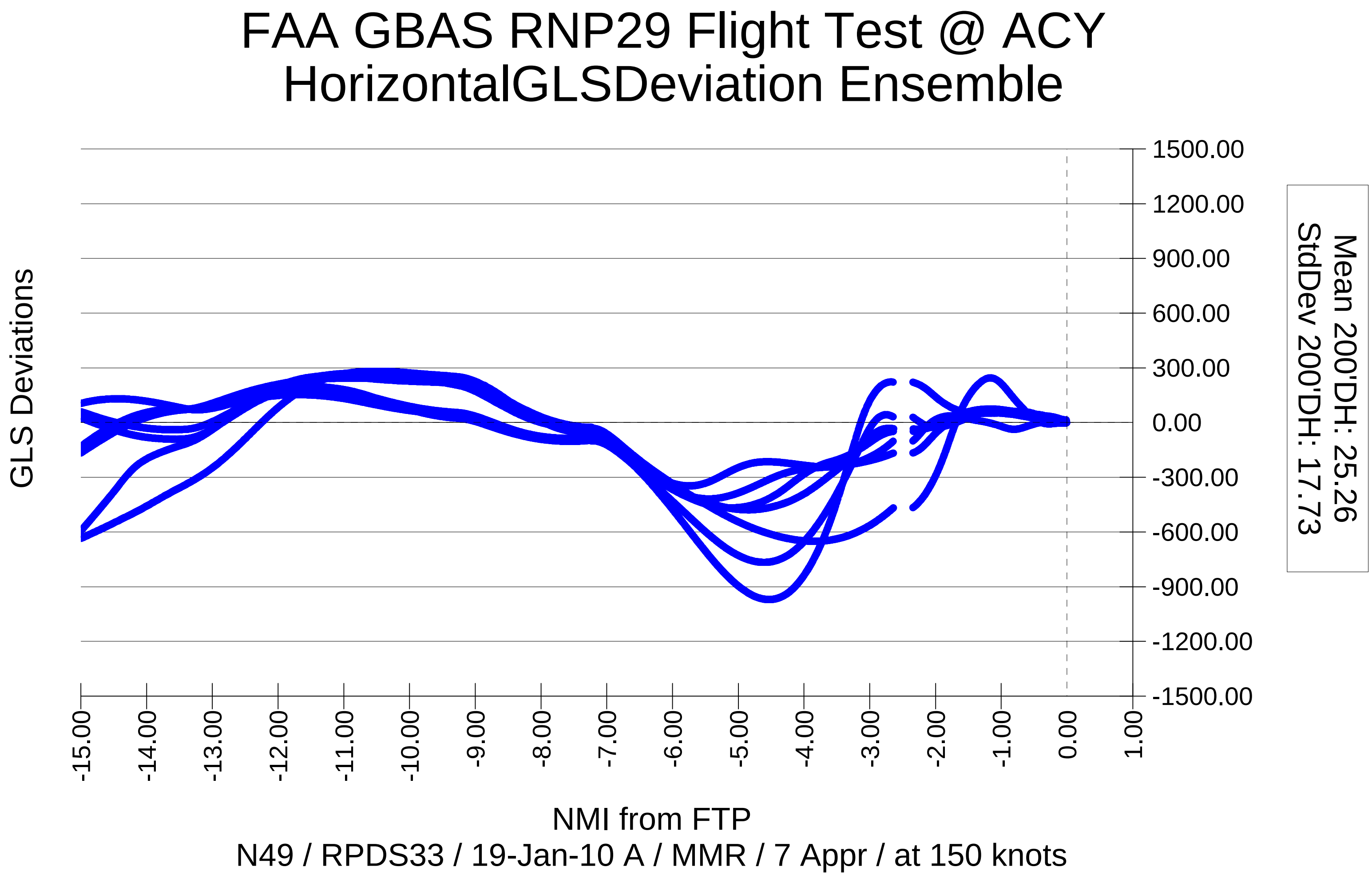
ACY RNAV (RNP) Plan View



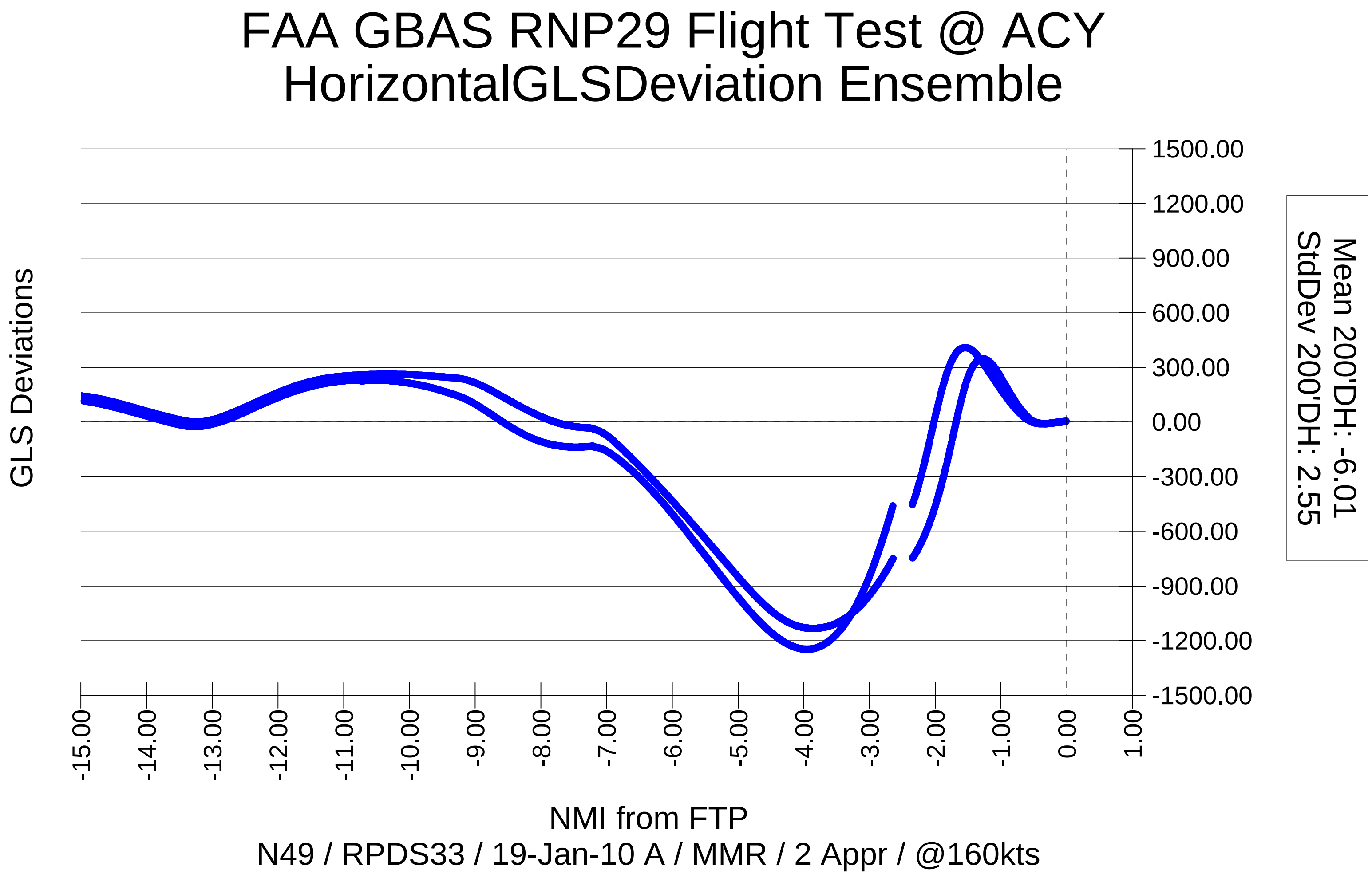
ACY RNAV (RNP) Plan View



ACY RNAV (RNP) Flight Technical Error

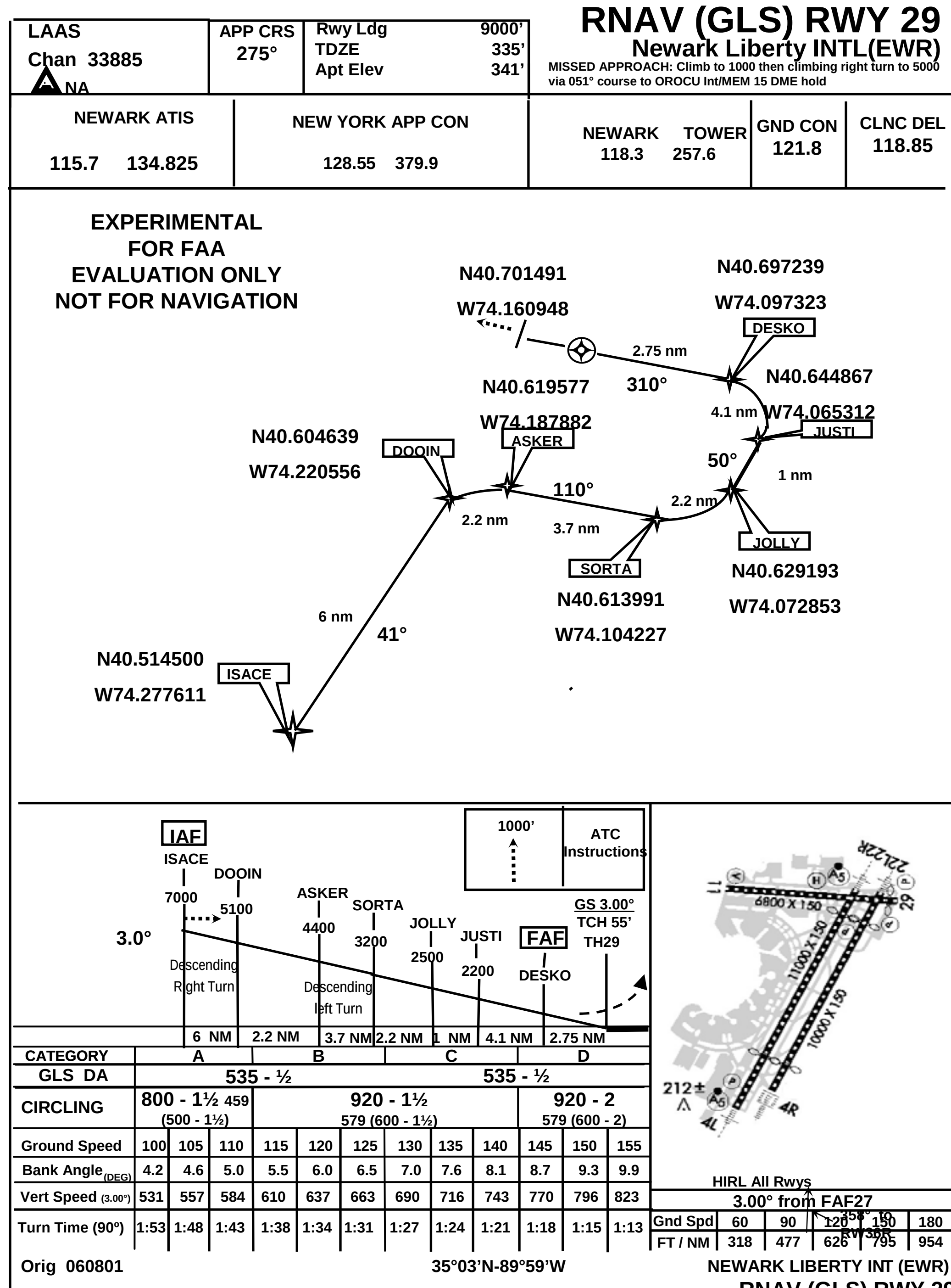


ACY RNAV (RNP) Flight Technical Error

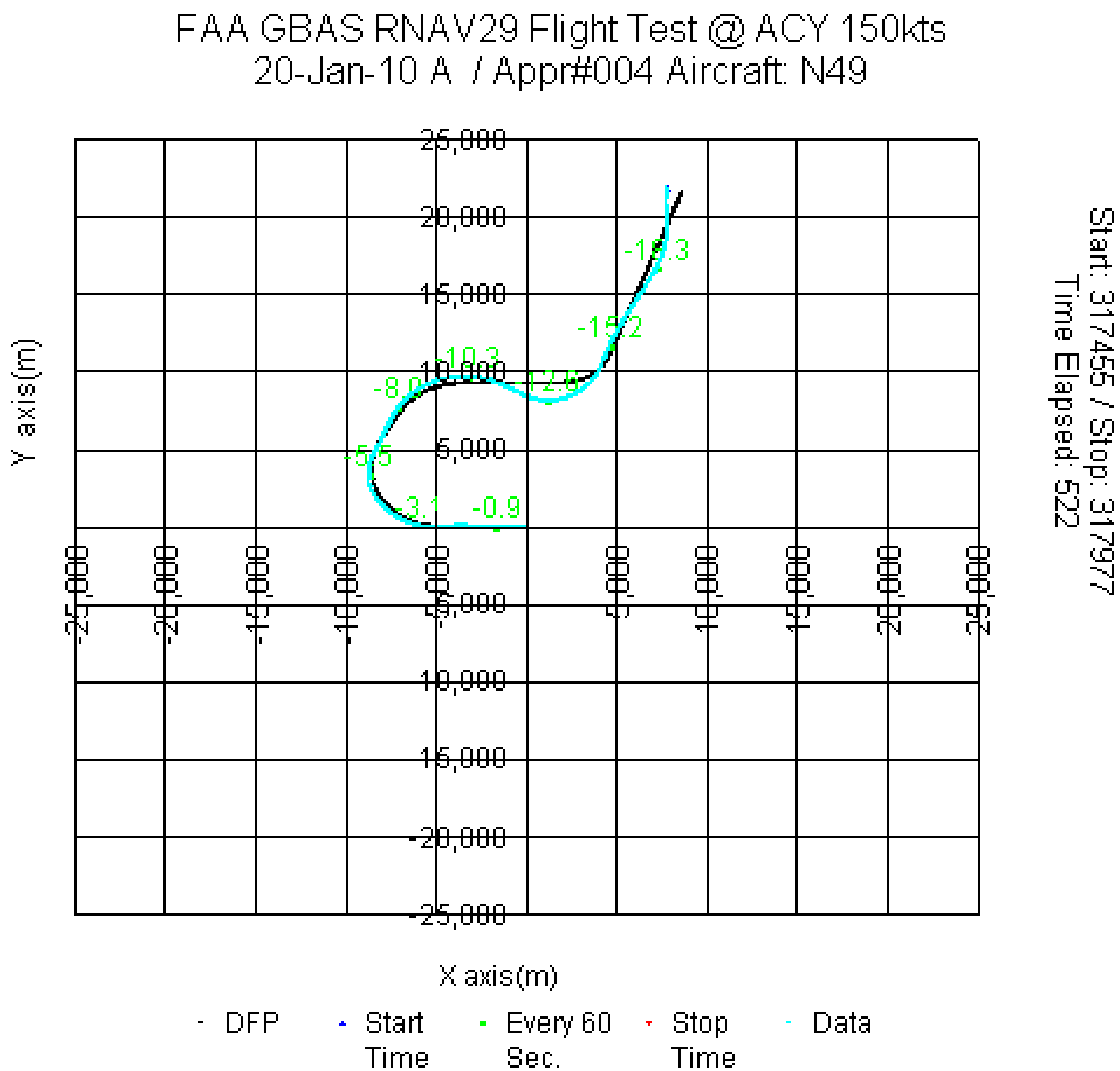


Newark RWY 29

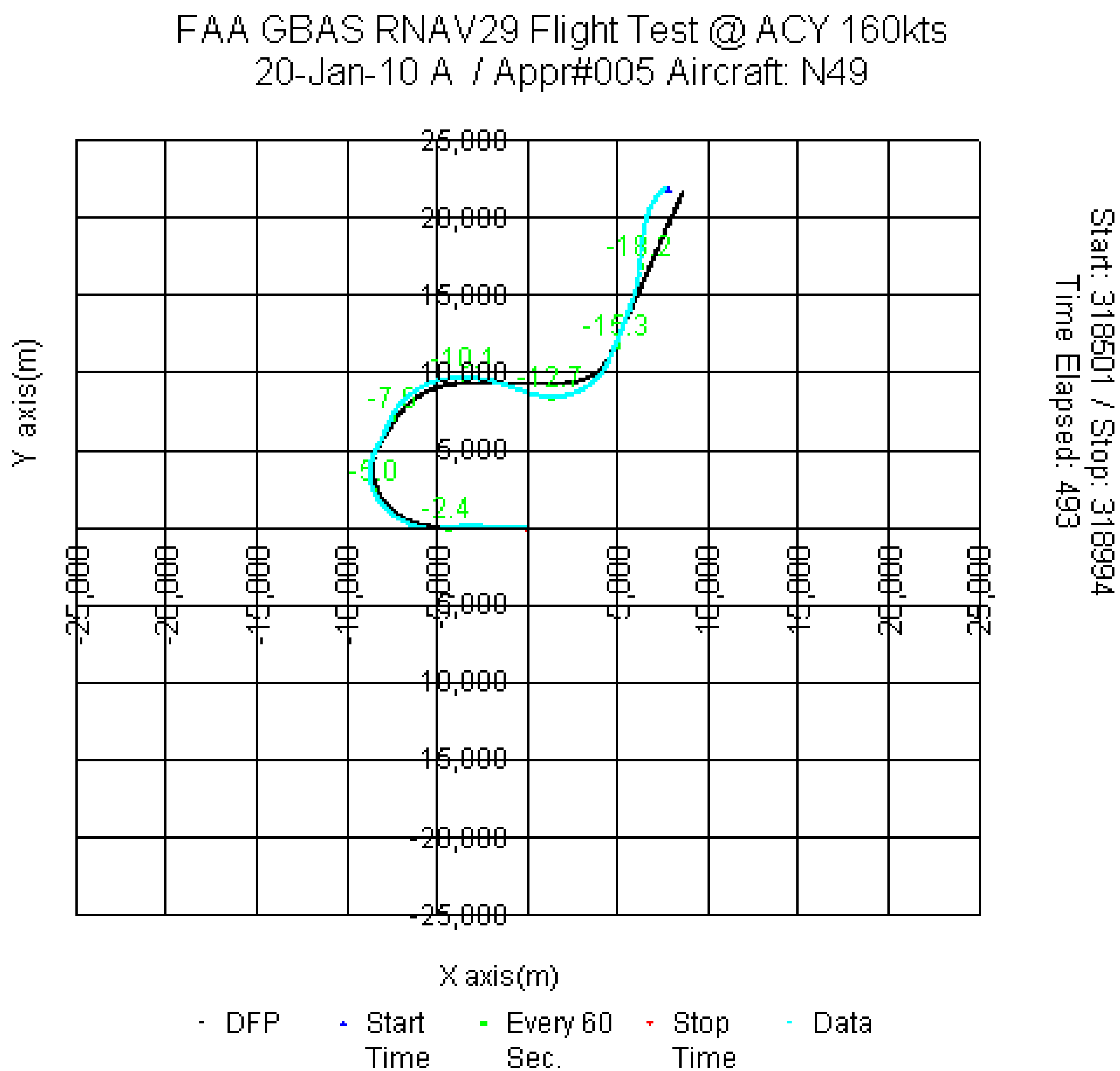
Prototype LAAS TAP



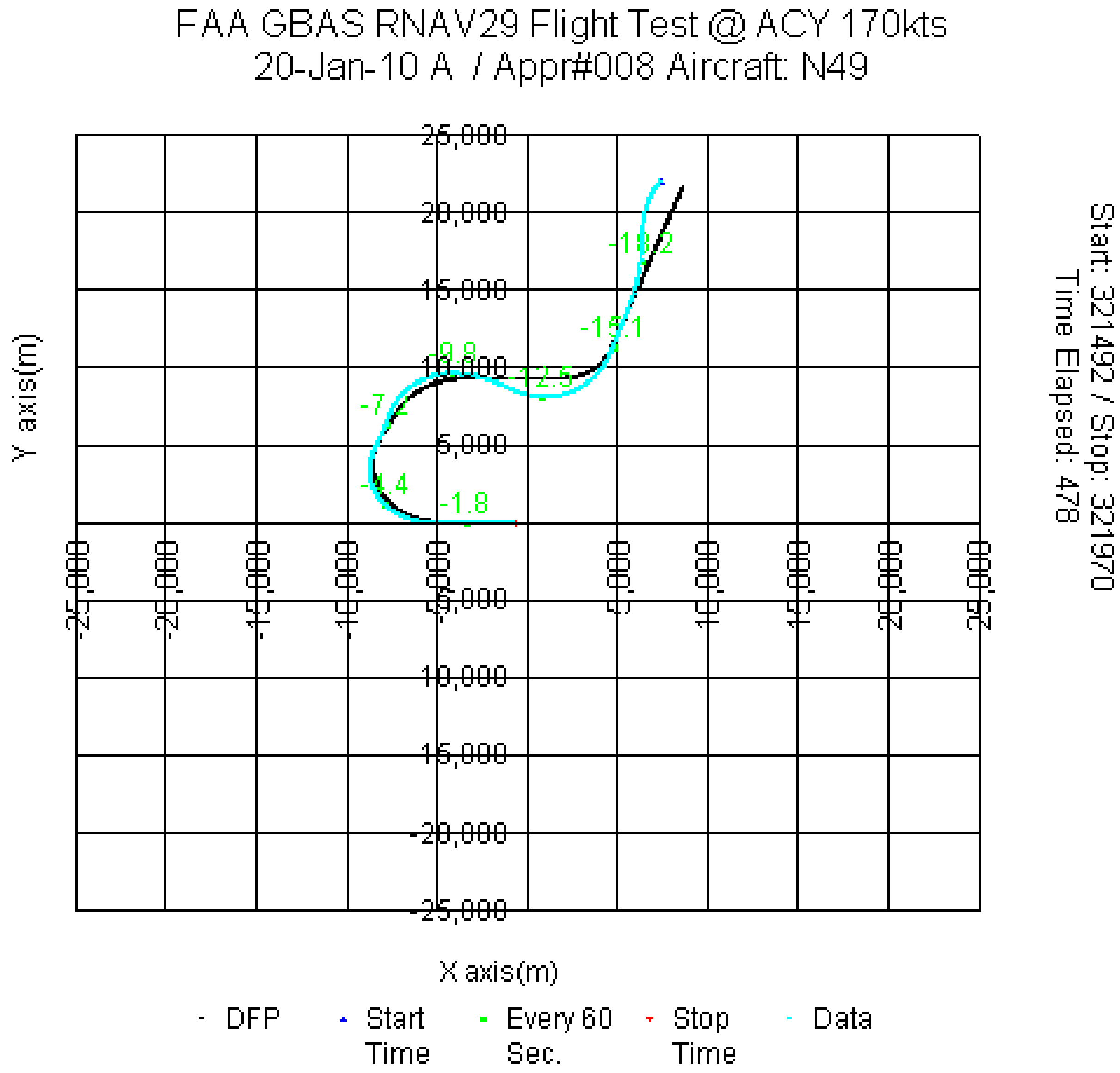
ACY RNAV (GLS) Plan View



ACY RNAV (GLS) Plan View



ACY RNAV (GLS) Plan View



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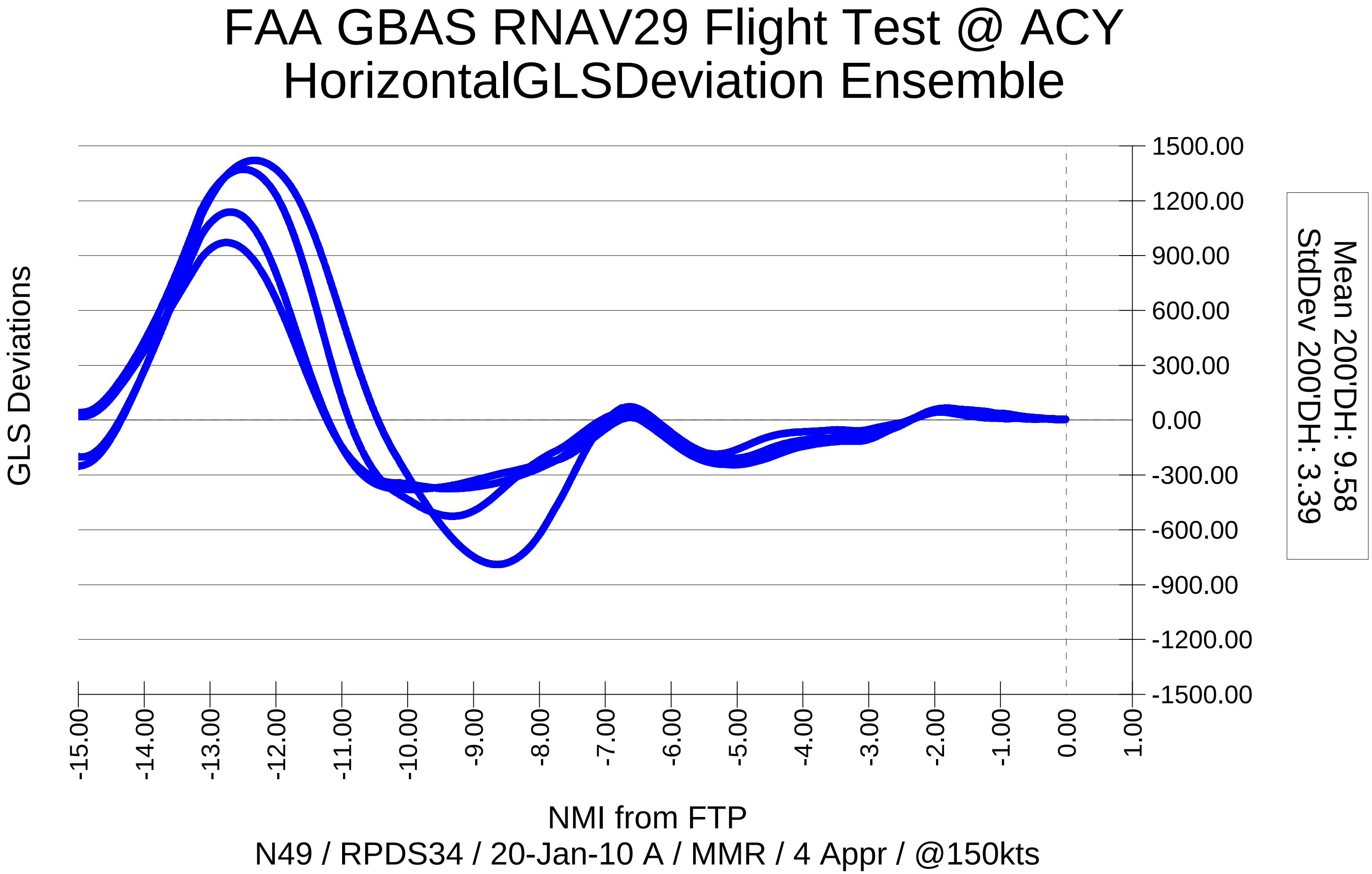
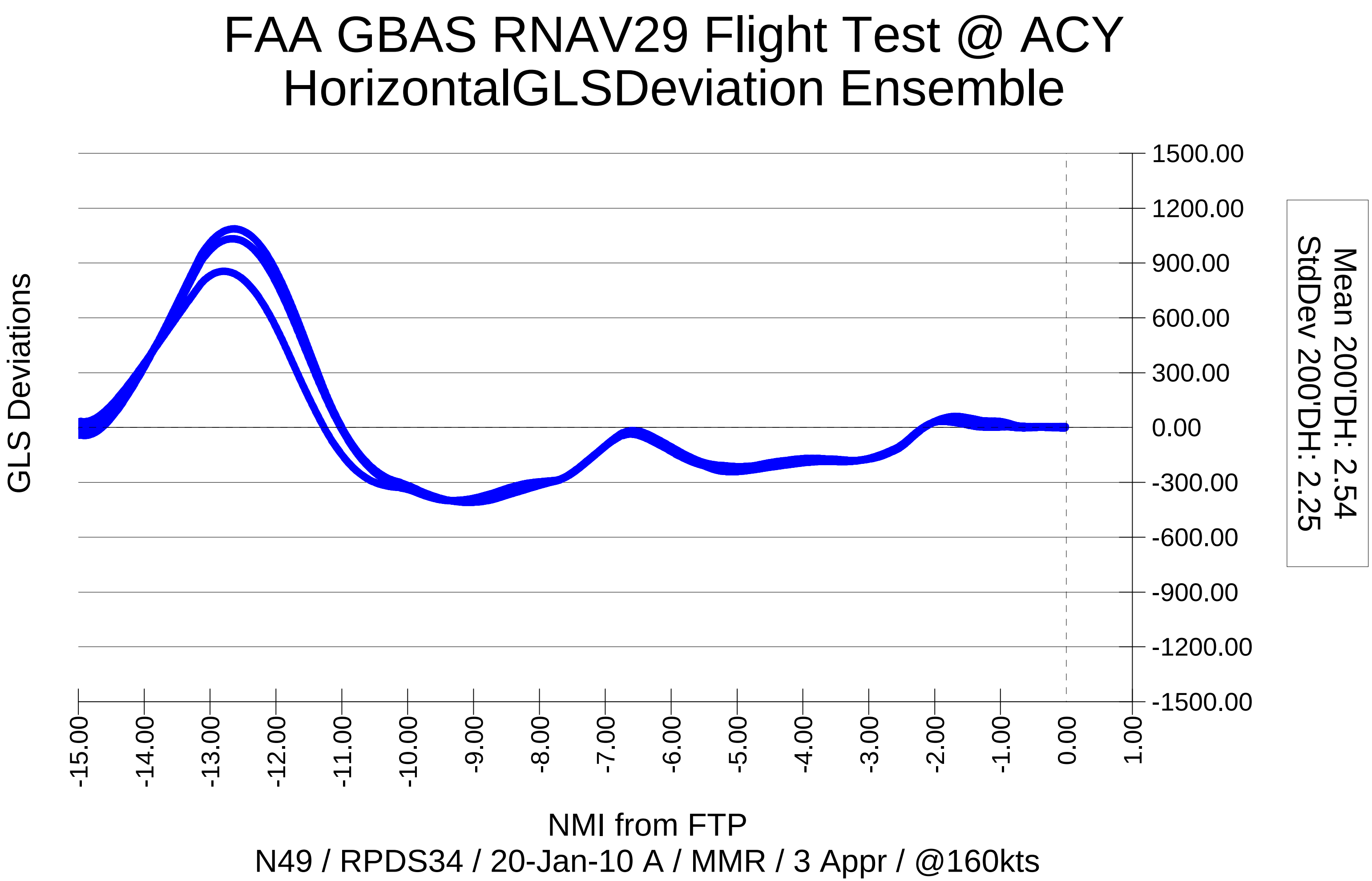


ACY RNAV (GLS) Flight Technical Error



Path Shape Considerations

- An area of continuing study is how to best address non-FMS aircraft
- An R&D project, Terminal Area Path (TAP), provides steering guidance for complex paths
  - These paths would exactly overlay RNP procedures
- If the RNP were designed such that ILS autopilots could fly them with minimal FTE, more costly aircraft upgrades could be avoided
  - Easing mixed equipage issues

Procedure Development Phases (cont.)

- Third Phase
  - Curved approaches to Runways 04L/R and 11
    - Same concept of obtaining input from air traffic and flight testing at the Tech Center applies for this stage of procedure development
- Fourth Phase
  - Displaced threshold approach to Runway 22R
- Final Phase
  - Closely spaced parallels and time, spacing, metering and sequencing procedures
  - Input from air traffic and flight testing are crucial

Summary

- The Local Area Augmentation System (LAAS) is one of the FAA Satellite Navigation programs.
  - Current work is geared toward supporting FAA and industry decision points on equipage.
- Project Newark is a NextGen operational demonstration.
  - Will identify performance based navigation procedures that will support capacity and efficiency enhancements.
  - Will also be used to help make decisions on LAAS implementation.