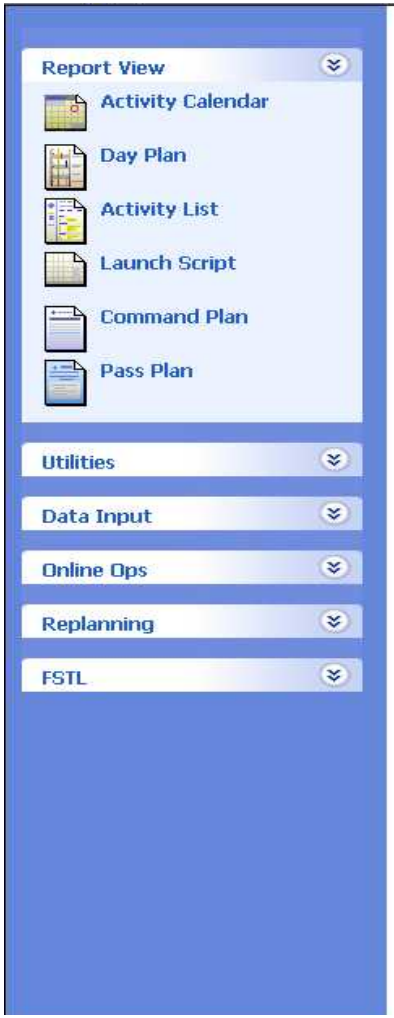
Aura Mission Planning Tool



EOS AURA

mission planning

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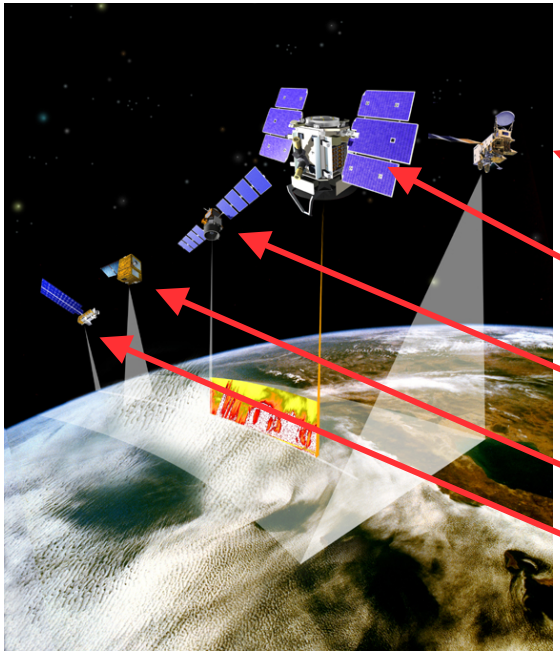
Topics

- **EOS Missions A-Train**
- **How We Got Here**
- **Heritage Pre Launch Planning**
- **Launch Operations**
- **Solution**
- **Aura Ops Concept**
- **Long Term Plan Activities Structures**
- **Activity List**
- **Daily Planning**
- **LEO Activity List**
- **Long Term Plan Execution**
- **Command Plan Concept**
- **Day Plan Features**
- **Electronic Signature Process**
- **Change Request Classes**
- **Summary**

EOS Mission's A- Train

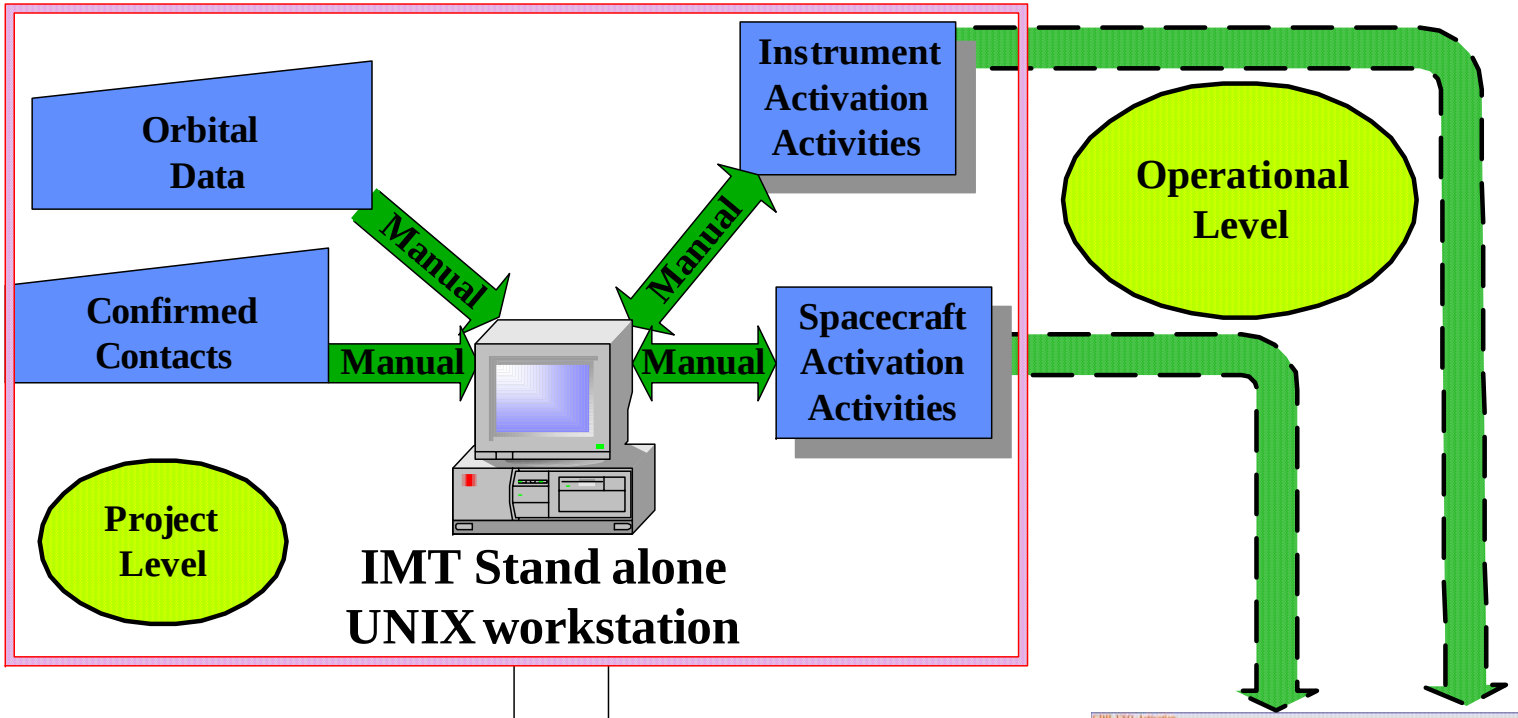


- **Earth Observing System (EOS) Aqua Launched 4 May 2002**
- **Earth Observing System (EOS) Aura Launched 15 July 2004**
- **Frozen, Sun-synchronous, 98.2-degree inclination**
- **705-km mean altitude over Equator, 1:30 p.m. to 2:00 p.m. ascending node mean local time**
- **Aura's mission is to study the Earth's ozone, air quality and climate. This mission is designed exclusively to conduct research on the composition, chemistry and dynamics of the Earth's upper and lower atmosphere employing multiple instruments on a single satellite.**

How We Got Here

- Heritage
  - Typically no tool had been used for Early Orbit Activation Planning and Execution
- Problem
  - Pre Launch Planning provided a static plan.
    - » **It was only useful as reference.**
  - Activation Planning was done by hand
    - » **Inefficient and inflexible**
- Aura's Headstart
  - Earth Observing System (EOS) Common Spacecraft Bus
    - » **Time could be devoted to improvements**
  - Aqua's Launch Team transitioned to the Aura Project.
  - The Ops Concepts of the Aqua and Aura were almost identical
  - Shared resources were on hand and available
    - » **Less overhead incurred in the development of this Tool.**

Heritage Pre Launch Planning

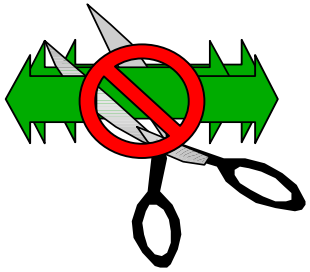


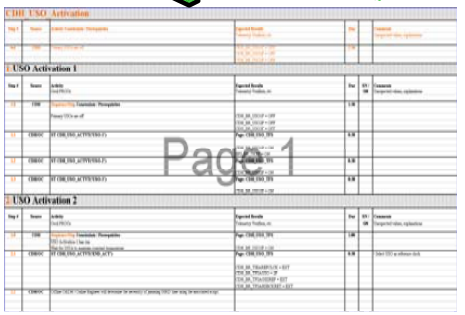
-Hi Level PDF Gantt Chart

-No way to export data

-Could not be quickly updated to display actual times

Integrated Mission Timeline





Sequence List
Activity Details Gleanned from SC Testing and Product development

Launch Operations

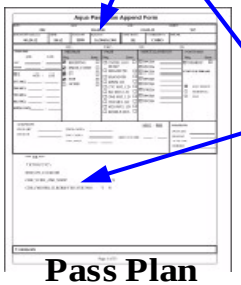
Activity Timing

Integrated Mission Timeline

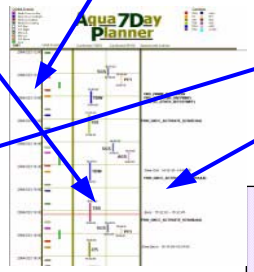
Reference Only

Confirmed Contact Schedule

Orbital Event Data

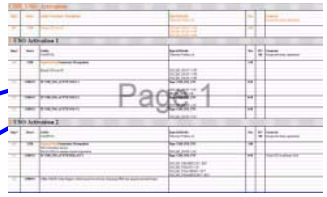


Pass Plan

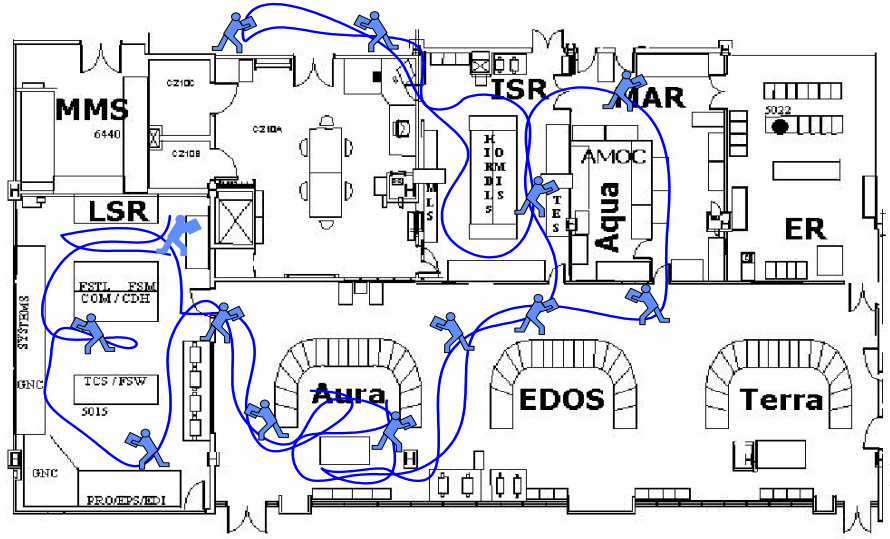


Aqua 7 Day Plan

Activity Contents

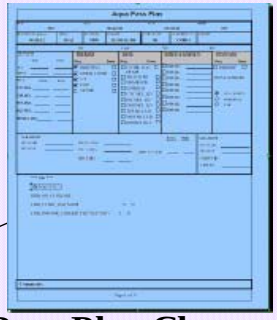


Sequence List



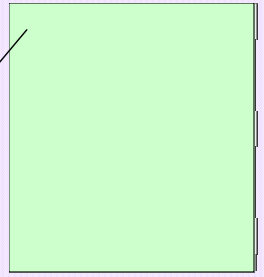
Manual Distribution

Used to change Approve Pass Plans



Pass Plan Change Request

Used to Modify Pass Plans in the approval cycle

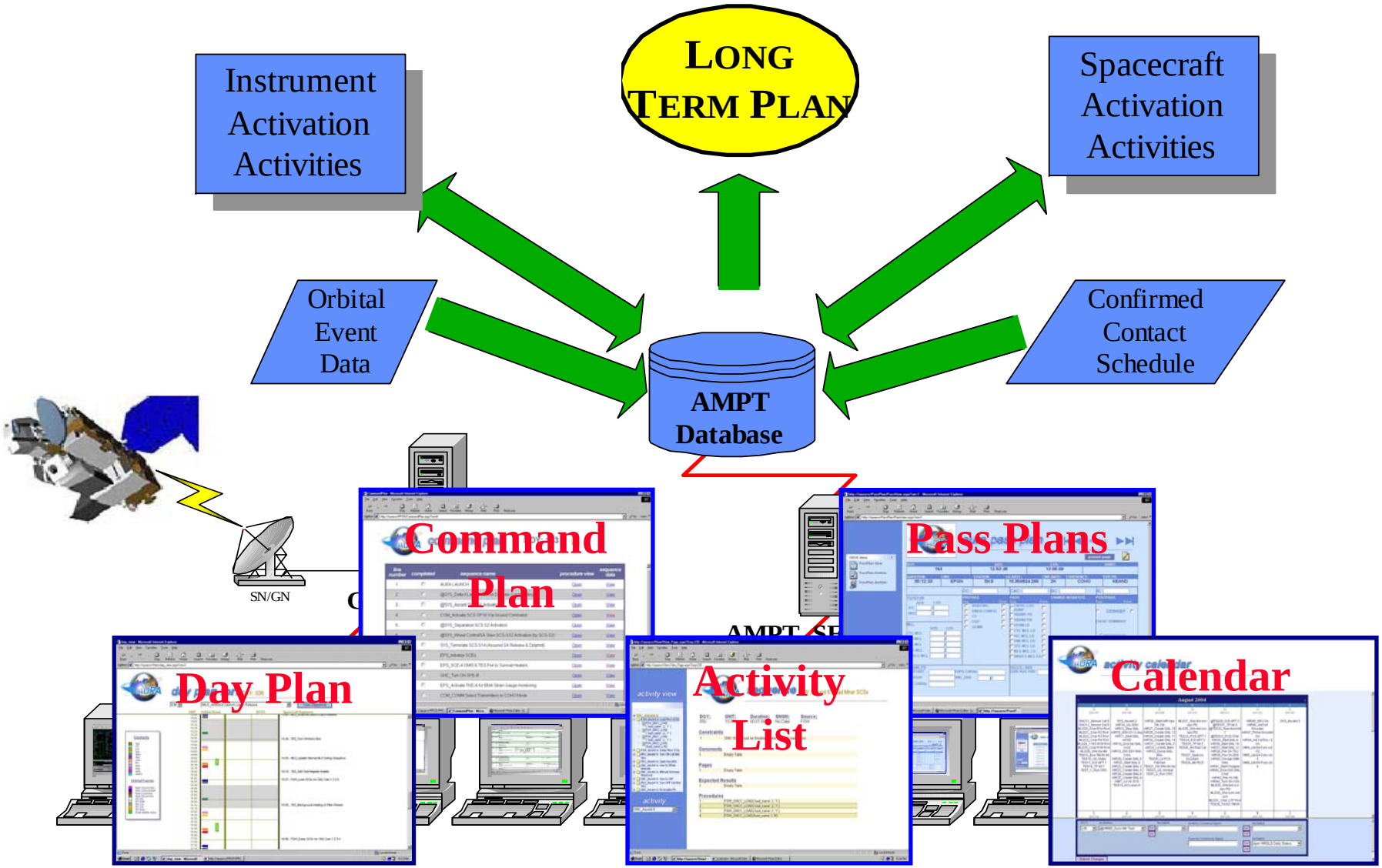


Pass Plan Append Form

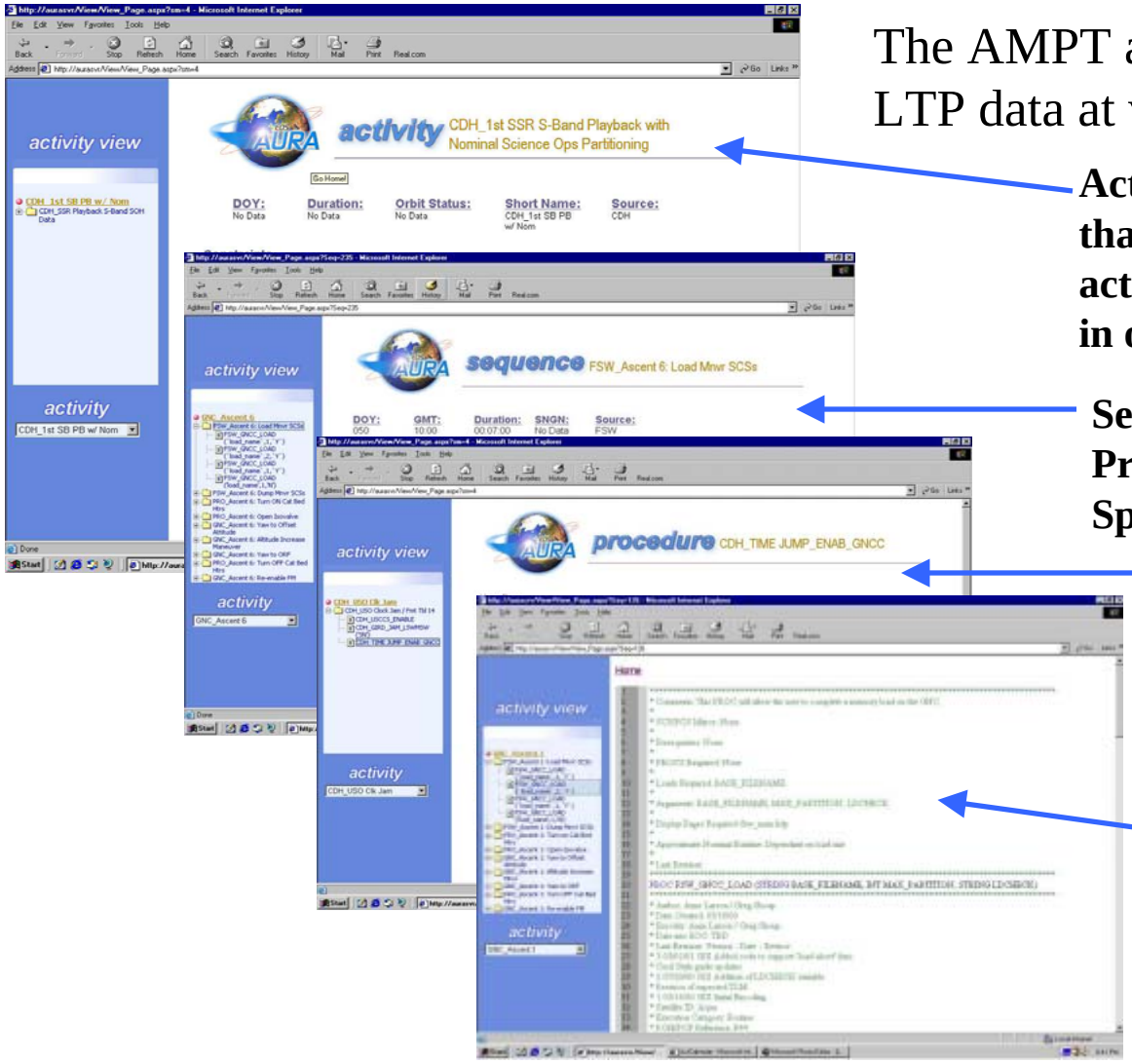
Solution

- **Develop a tool that will be used for the Activation Timeline from inception to execution**
- **Aura Mission Planning Tool**
  - **Database driven, web hosted tool to perform all planning functions and change request processes**
  - **Dynamic mission planning tool to coordinate flight operations.**
    - » Planning Products
      - Launch Activity Data
      - Long Term Calendar
      - Day Plan
    - » Execution Products
      - Change Request
      - Command Plan
      - Pass Plans
  - **Mission Phases supported**
    - » pre-launch LEO timeline development
    - » Spacecraft Tests with SC Manufacturer
    - » Mission Rehearsals
    - » LEO replanning,

Aura Ops Concept



Long Term Plan Activities Structures



The AMPT allows the FST to view the LTP data at various levels of details.

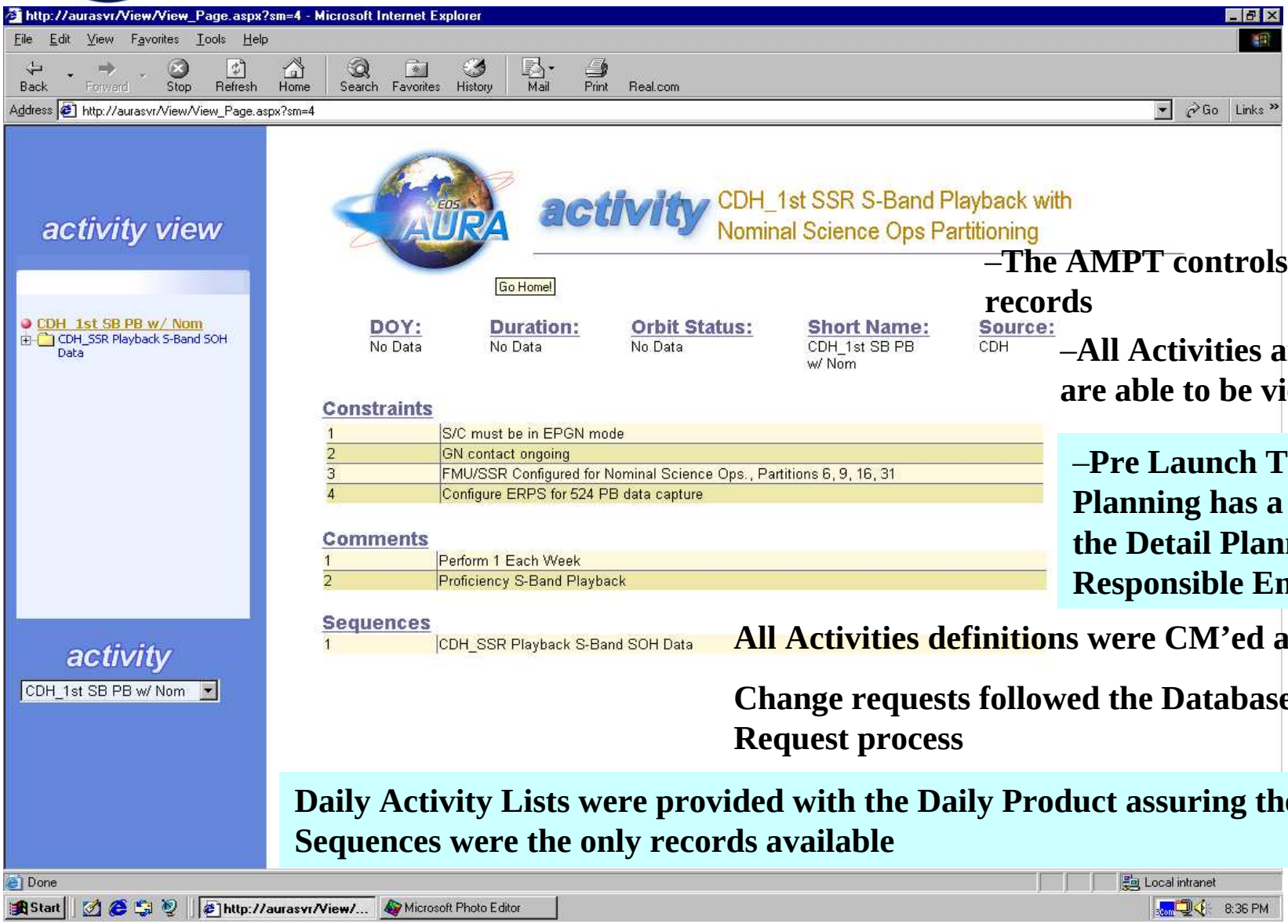
Activity: A group of related Sequences that can performs an iterative step in the activation process and can be completed in one day

Sequence: A group of related CECIL Proc's that must be run during a single Spacecraft Contact

Procedure: Cecil Procs with Augments, all Telemetry Verifiers and which telemetry pages to use to verify the Proc

Proc View: Opens Cecil Procs from Ground systems CM Directory

Activity List



–The AMPT controls all Activity list records

–All Activities and sequences are able to be viewed online

–Pre Launch Timeline Planning has a direct Link to the Detail Planning by the Responsible Engineers

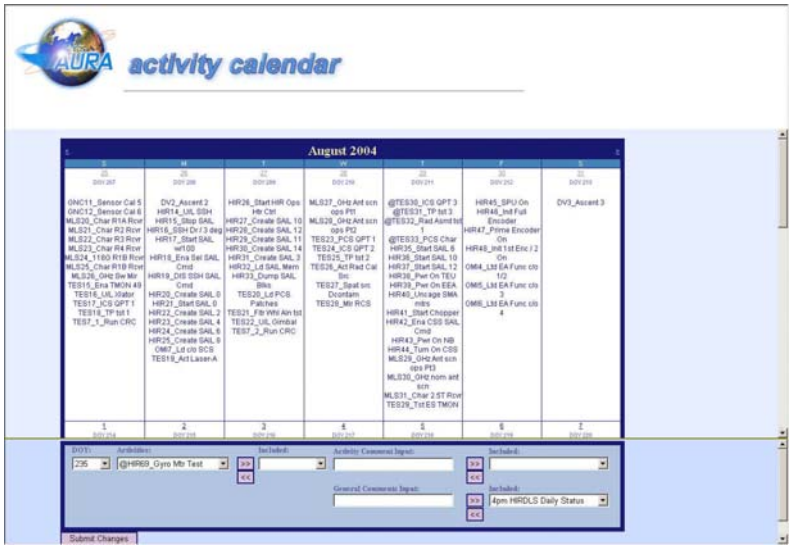
All Activities definitions were CM'ed after Baseline

Change requests followed the Database Change Request process

Daily Activity Lists were provided with the Daily Product assuring the CM'ed Sequences were the only records available

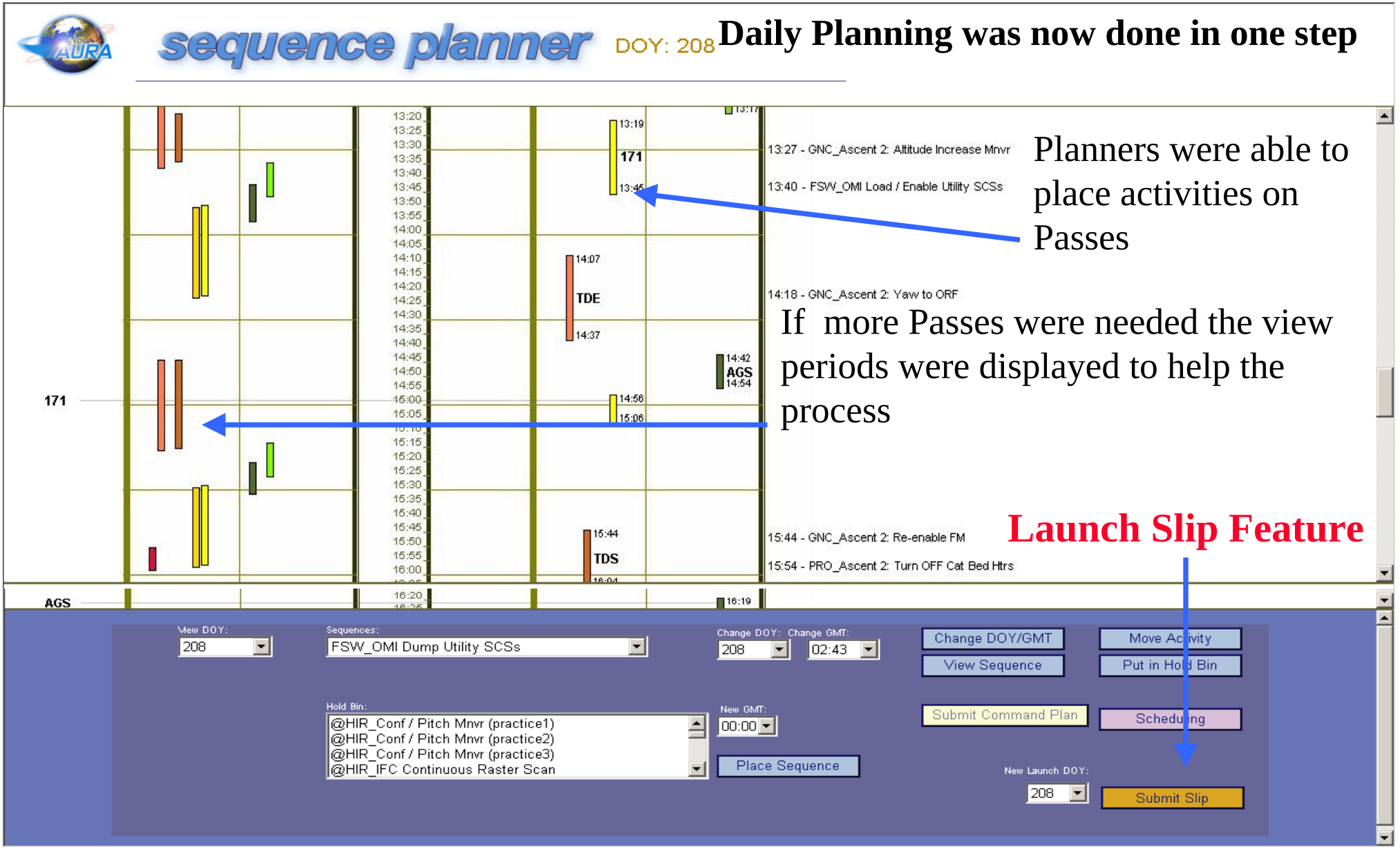
Long Term Calendar

•Heritage Long Term Planning; Changes were made on a hard copy of a Mission Calendar which was provided back to the Planning Team so they could update their products



•Aura's Long Term Planning; Updates were made using Calendar edit page during the planning meeting. This was immediately reflected in the database

Daily Planning



Long Term Plan Execution

- The AMPT provided The Launch Team online access to all the Aura Planning and Execution Products.
- User Specific name and password for signature.
- The Flight Team Lead (FSTL) was provided a unique page to coordinate the daily activities.
- The Electronic Signature cycle was flexible
  - FSTL able to designate authorized signers.
- Online scorekeeping allowed a “As Run” document to be generated.
- The end result - Execution of the Long Term Plan using the tool that built it!

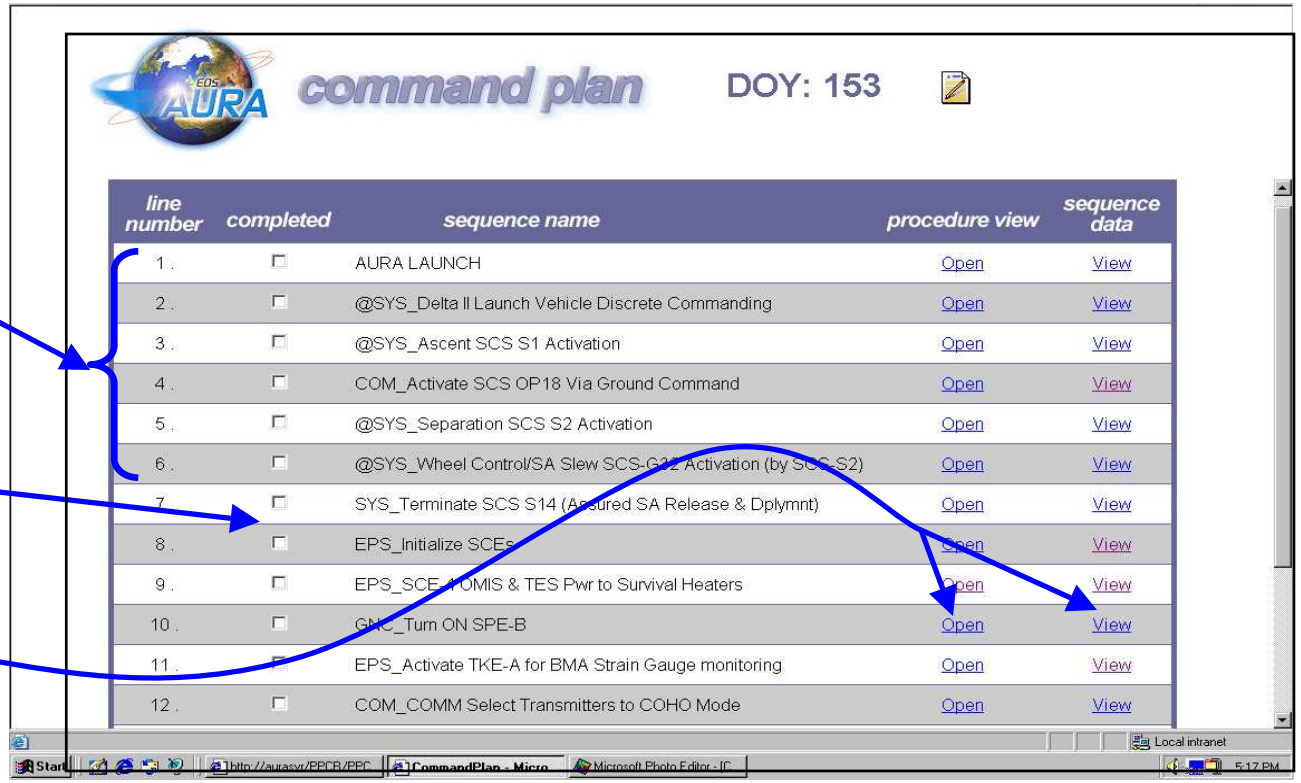
Command Plan Concept

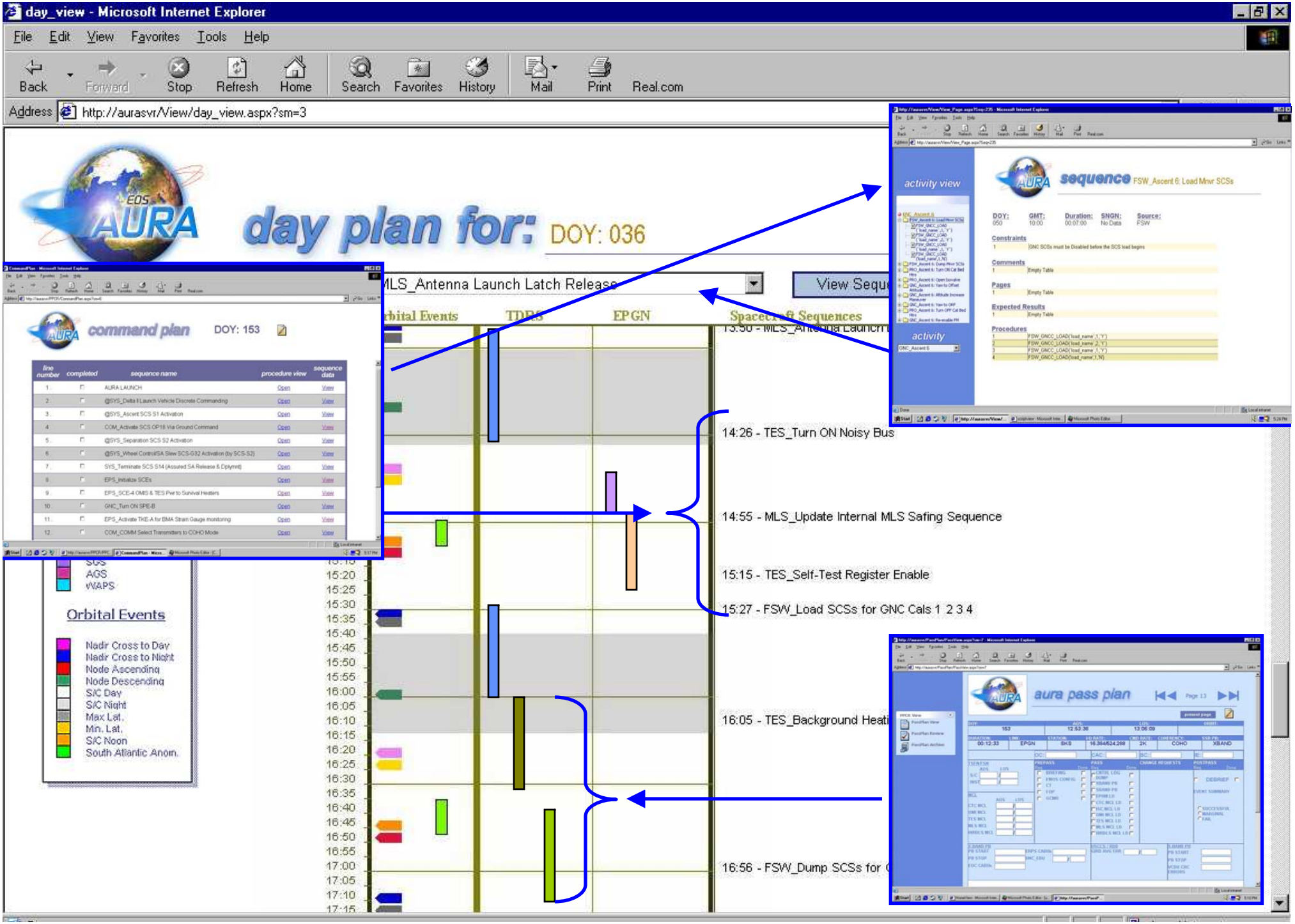
- The Command Plan was implemented as part of the Lessons Learned
  - Defines Order of Operation
  - Sequences are aligned with contacts on the Day Plan
  - Sequence and Procedure can marked completed

CR's will be required to reorder activities

FSTL has the ability to mark Sequence as completed for the "As Run" Detail

The Command Plan Links to Proc and Sequence Details




day_view - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Print Real.com
Address http://aurasvr/View/day_view.aspx?sm=3
day plan for: DOY: 036
MLS_Antenna Launch Latch Release
View Seque
Orbital Events
TDRS
EPGN
Spacecraft Sequences
command plan
DOY: 153
line number
completed
sequence name
procedure view
sequence data
1 ALRA LAUNCH Open View
2 @SYS_Delta II Launch Vehicle Discrete Commanding Open View
3 @SYS_Ascent SCS S1 Activation Open View
4 COM_Activate SCS OP18 Via Ground Command Open View
5 @SYS_Separation SCS S2 Activation Open View
6 @SYS_Wheel Control/SA Slew SCS-G32 Activation (by SCS-S2) Open View
7 SYS_Terminate SCS S14 (Assured SA Release & Dplymnt) Open View
8 EPS_Initialize SCEs Open View
9 EPS_SCE-4 OMS & TES Pwr to Survival Heaters Open View
10 GNC_Turn ON SPE-B Open View
11 EPS_Activate TKE-A for BMA Strain Gauge monitoring Open View
12 COM_COMM Select Transmitters to COHO Mode Open View
activity view
activity
sequence FSW_Ascent 6: Load Mnvr SCSs
DOY: 050
GMT: 10:00
Duration: 00:07:00
SNGN: No Data
Source: FSW
Constraints
GNC SCSs must be Disabled before the SCS load begins
Comments
Empty Table
Pages
Empty Table
Expected Results
Empty Table
Procedures
FSW_GNCC_LOAD(load_name,1,'Y')
FSW_GNCC_LOAD(load_name,2,'Y')
FSW_GNCC_LOAD(load_name,3,'Y')
FSW_GNCC_LOAD(load_name,1,'N')
14:26 - TES_Turn ON Noisy Bus
14:55 - MLS_Update Internal MLS Safing Sequence
15:15 - TES_Self-Test Register Enable
15:27 - FSW_Load SCSs for GNC Cals 1 2 3 4
16:05 - TES_Background Heati
16:58 - FSW_Dump SCSs for
AGS
WAPS
Orbital Events
Nadir Cross to Day
Nadir Cross to Night
Node Ascending
Node Descending
S/C Day
S/C Night
Max Lat.
Min. Lat.
S/C Noon
South Atlantic Anom.
15:20
15:25
15:30
15:35
15:40
15:45
15:50
15:55
16:00
16:05
16:10
16:15
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16:25
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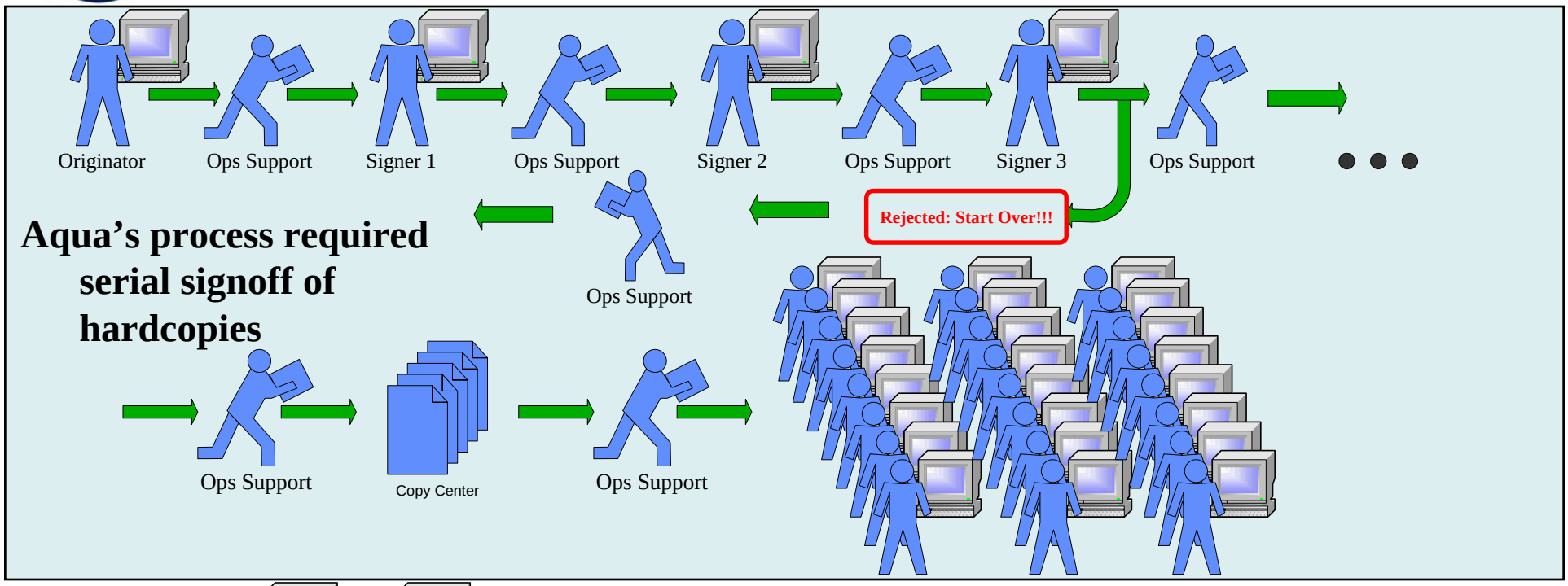
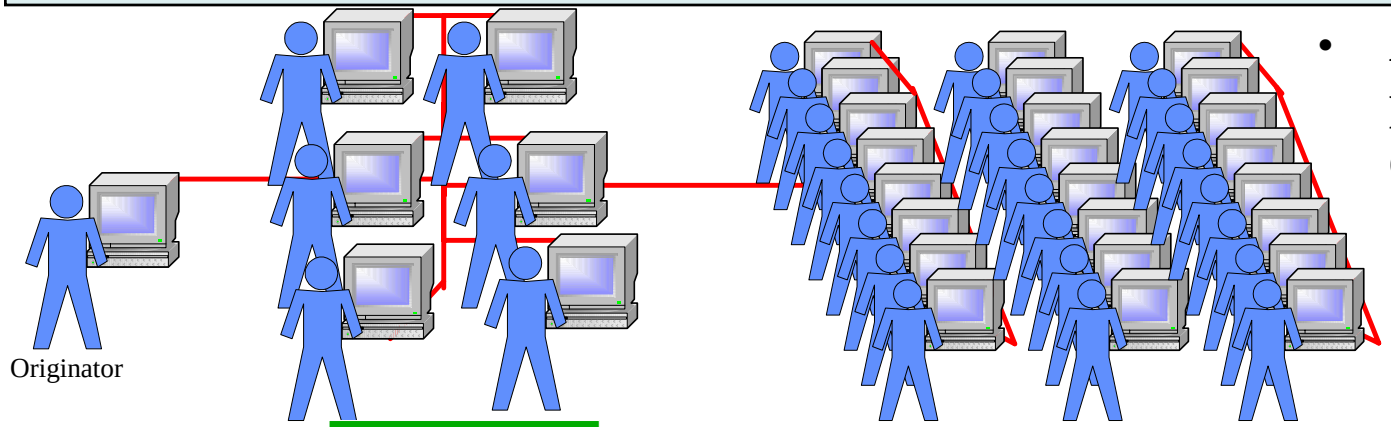
aura pass plan

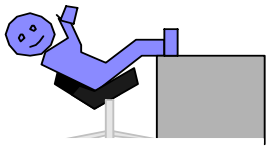
Electronic Signature



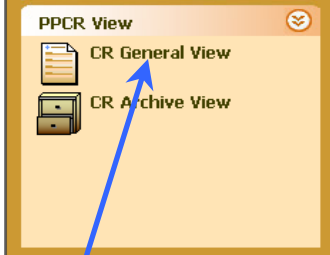
Aqua's process required serial signoff of hardcopies



- **Aura's process allows parallel signoff of electronic forms**



Change Request Classes



Draft CR's allowed users flexibility and error Checking prior to submitting

CR's which are allowed Multiple execution over a Calendar Day.

change request general view

CR's which have been submitted and are in the review cycle

pending authorization

Severity	CR Num	CR Title	CR Type	Execution Type	Submit Time	AOS DOY	AOS GMT	CR Review	Status View	Expedite	Withdraw	Print
Routine	032-007	Perform EPS State of Health test on ARE 3-C (ARM 6)	Pass Plan	Single TC	032:15:57	032	16:00	Review	Open	Expedite	Withdraw	Pr
Important	027-003	GIRD USO Freq. Adj. # 024. Either 8 or 12 Counts	Pass Plan	Single Open	032:17:20	N/A	N/A	Review	Open	Expedite	Withdraw	Pr

on-deck

Severity	CR Num	CR Title	CR Type	AOS DOY	AOS GMT	LOS DOY

Time Constrained CR's which have been approved and are waiting to be executed.. FSTL will direct the execution of these as required.

open

Severity	CR Num	CR Title	CR Type	S
Routine	033-002	HIRDLS Blockage Clearing - Load SAIL Scan Table 20	Pass Plan	aut
Routine	025-009	HIRDLS Stop SAIL Scan Table	Pass Plan	aut
Routine	018-006	HIRDLS Contingency to Stop SAIL Scanning	Pass Plan	aut
Routine	019-004	HIRDLS Restart TSS Scan	Pass Plan	aut
Routine	012-005	HIRDLS Disable and Enable TSS CSC	Pass Plan	aut
Routine	025-010	HIRDLS Run PAVE Science Scan SAIL Table 30 version 2	Pass Plan	aut

rejected

Severity	CR Num	CR Title	CR Type	AOS DOY	AOS GMT	Status	Resubmit View	Close CR	Print View
Critical	032-006	SSR Playback Kill	Pass Plan	N/A	N/A	rejected	View	Close	Print
Routine	033-004	HIRDLS Run PAVE Science Scan SAIL Table 30 version 2							

CR's which do not pass the signature cycle

close-out

CR Num	CR Title	Status	Close View	Reactivate	Completed?	Close CR
033-001	MCL/Ephemeris Load DOY 032	incomplete	View		☐	Close

CR's that have expired at the end of the day or after their execution window has closed

Summary

- **Aqua/Aura mission provided a unique opportunity to implement improvements.**
- **Available team members created the tool within scope and on time.**
- **Allowed all the *up front planning* efforts to directly ***translate*** into the *execution* of the activation timeline – Major increase in efficiency.**
- **Flexible enough for pre-launch planning, testing and mission rehearsals.**
- **Robust enough for activation and checkout of the mission.**
- **Friendly enough for normal operations.**
- **On-line CR process was a significant improvement in the ops process.**
- **Implementing the Command plan was a major improvement in Operations and caused a decrease in CR's submitted.**