



Aura Mission Planning Tool



mission planning

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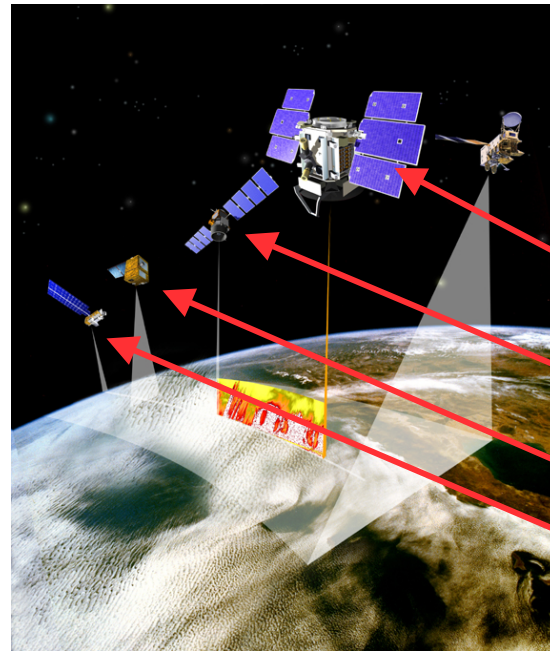


Topics

- **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



Aqua
Cloudsat
CALIPSO
PARASOL
Aura



- 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.

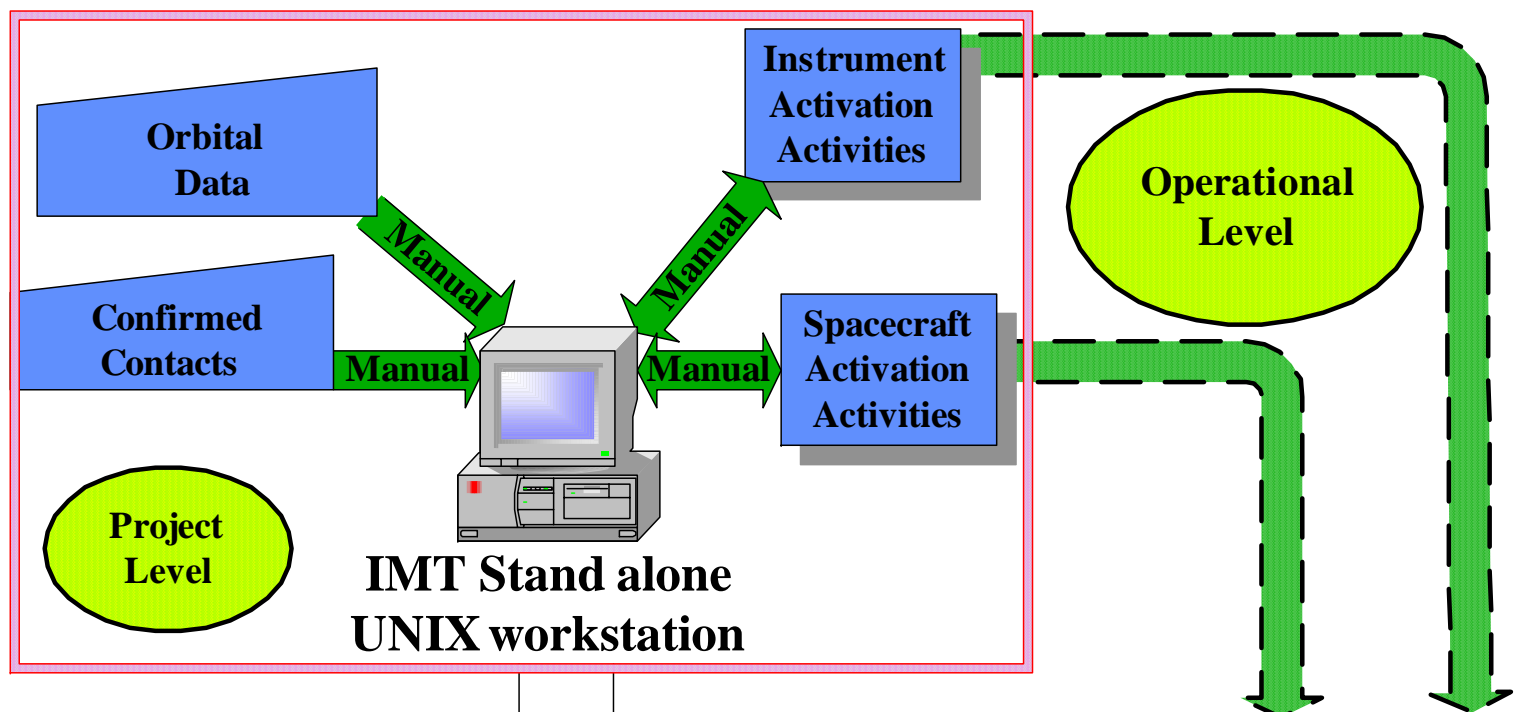


How We Got Here

- 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

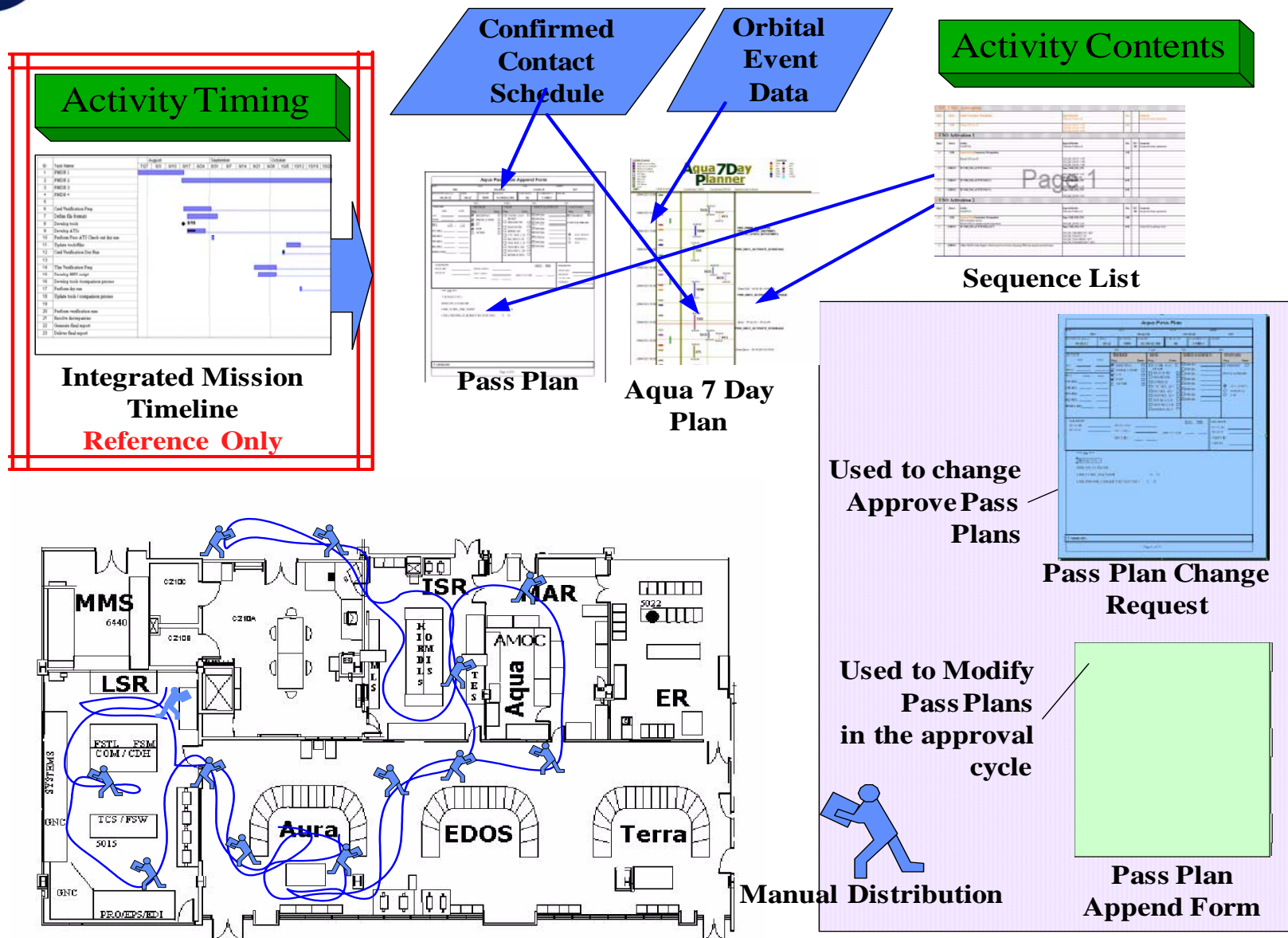


The table is titled **Sequence List** and shows activity details. It includes columns for activity name, duration, and other relevant information. The table is divided into sections for different mission phases, with activities listed in a structured manner.

Sequence List
Activity Details Gleaned from SC Testing and Product development



Launch Operations



25 January 2005

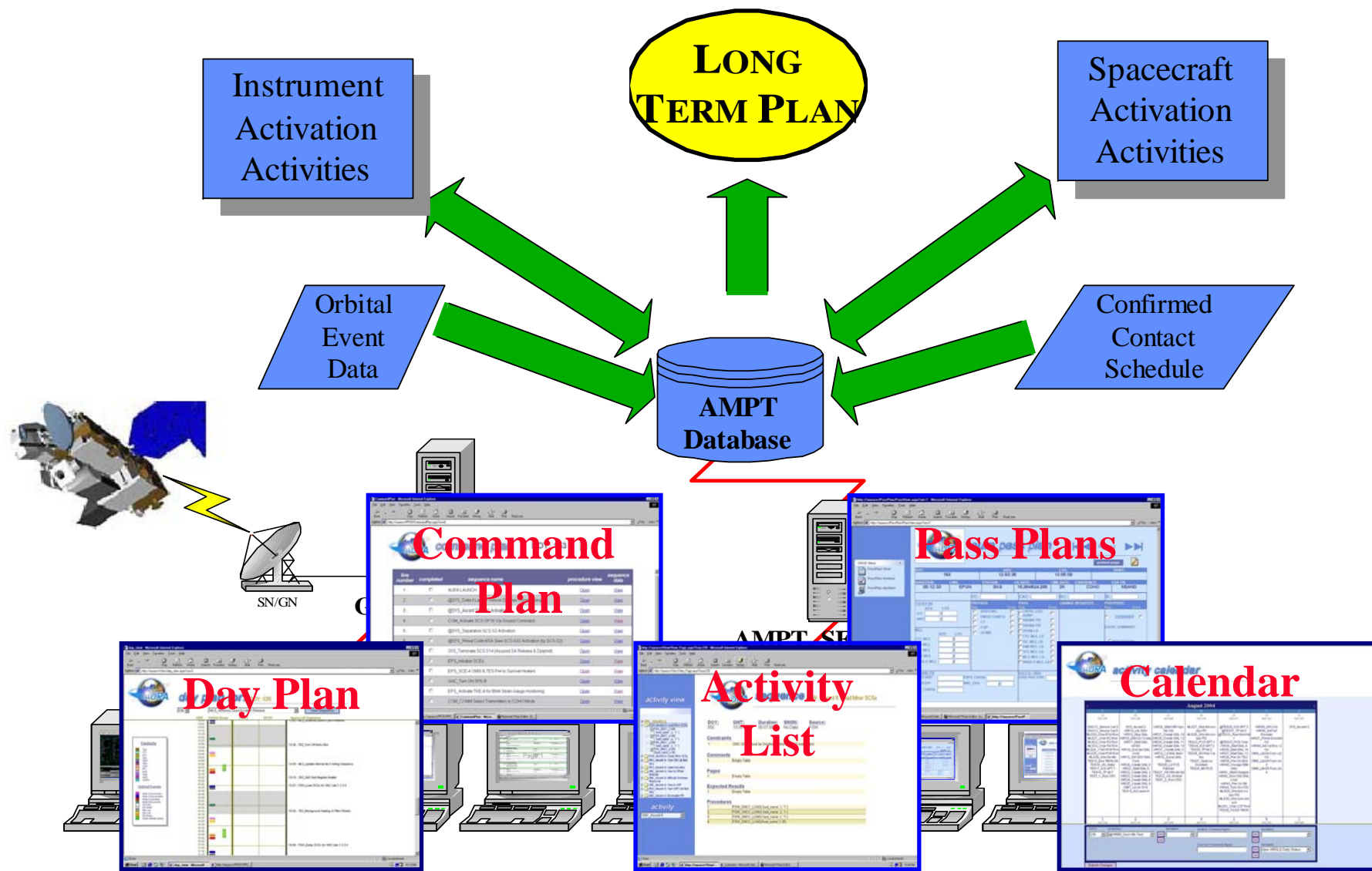


Solution

- **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,



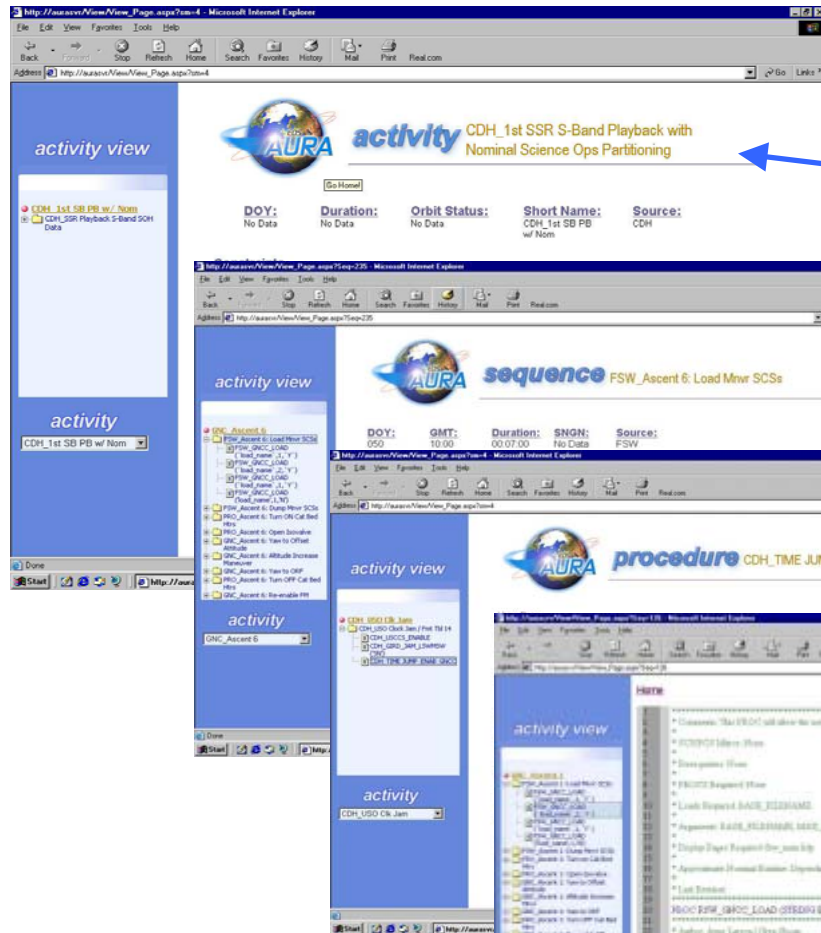
Aura Ops Concept



25 January 2005



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

http://aurasvr/View/View_Page.aspx?sm=4 - 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/View_Page.aspx?sm=4 Go Links

activity view

CDH_1st SB PB w/ Nom
CDH_SSR Playback S-Band SOH Data

activity
CDH_1st SB PB w/ Nom

AURA activity CDH_1st SSR S-Band Playback with Nominal Science Ops Partitioning

[Go Home!](#)

DOY: No Data
Duration: No Data
Orbit Status: No Data
Short Name: CDH_1st SB PB w/ Nom
Source: CDH

Constraints

1	S/C must be in EPGN mode
2	GN contact ongoing
3	FMU/SSR Configured for Nominal Science Ops., Partitions 6, 9, 16, 31
4	Configure ERPS for 524 PB data capture

Comments

1	Perform 1 Each Week
2	Proficiency S-Band Playback

Sequences

1	CDH_SSR Playback S-Band SOH Data
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Annotations:

- The AMPT control records
- All Activities are able to be v
- Pre Launch Planning has the Detail Plan Responsible E
- All Activities definitions were CM'ed
- Change requests followed the Database Request process
- Daily Activity Lists were provided with the Daily Product assuring the Sequences were the only records available

Done Local intranet 8:36 PM

–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'd after Baseline

Change requests followed the Database Change Request process

Daily Activity Lists were provided with the Daily Product assuring the CM'd 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

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

AURA activity calendar						
August 2004						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
GNC11_Sensor Cal 5 GNC12_Sensor Cal 6 ML320_Chap R1A Row ML320_Chap R2 Row ML320_Chap R3 Row ML320_Chap R4 Row ML324_T180 R1B Row ML320_Chap R1B Row ML326_Op2 Sw Mir TEST11_Ena TMON 49 TEST16_ULN TMON TEST17_JCS QPT 1 TEST18_TP Test 1 TEST7_L_Run CRC	DVS_Assent 2 HR14_ULN SDH HR15_SSH QPT 3 HR17_Start SAL HR18_Ena Sal SAL HR19_Op2 SDH SAL HR20_Start SAL 0 HR21_Start SAL 0 HR22_Start SAL 4 HR23_Start SAL 8 HR24_Start SAL 8 HR25_Start SAL 8 HR26_Start SAL 8 HR27_Start SAL 8 HR28_Start SAL 8 HR29_Start SAL 8 HR30_Start SAL 8 HR31_Start SAL 8 HR32_Start SAL 8 HR33_Start SAL 8 HR34_Start SAL 8 HR35_Start SAL 8 HR36_Start SAL 8 HR37_Start SAL 8 HR38_Start SAL 8 HR39_Start SAL 8 HR40_Start SAL 8 HR41_Start SAL 8 HR42_Start SAL 8 HR43_Start SAL 8 HR44_Start SAL 8 HR45_Start SAL 8 HR46_Start SAL 8 HR47_Start SAL 8 HR48_Start SAL 8 HR49_Start SAL 8 HR50_Start SAL 8 HR51_Start SAL 8 HR52_Start SAL 8 HR53_Start SAL 8 HR54_Start SAL 8 HR55_Start SAL 8 HR56_Start SAL 8 HR57_Start SAL 8 HR58_Start SAL 8 HR59_Start SAL 8 HR60_Start SAL 8 HR61_Start SAL 8 HR62_Start SAL 8 HR63_Start SAL 8 HR64_Start SAL 8 HR65_Start SAL 8 HR66_Start SAL 8 HR67_Start SAL 8 HR68_Start SAL 8 HR69_Start SAL 8 HR70_Start SAL 8 HR71_Start SAL 8 HR72_Start SAL 8 HR73_Start SAL 8 HR74_Start SAL 8 HR75_Start SAL 8 HR76_Start SAL 8 HR77_Start SAL 8 HR78_Start SAL 8 HR79_Start SAL 8 HR80_Start SAL 8 HR81_Start SAL 8 HR82_Start SAL 8 HR83_Start SAL 8 HR84_Start SAL 8 HR85_Start SAL 8 HR86_Start SAL 8 HR87_Start SAL 8 HR88_Start SAL 8 HR89_Start SAL 8 HR90_Start SAL 8 HR91_Start SAL 8 HR92_Start SAL 8 HR93_Start SAL 8 HR94_Start SAL 8 HR95_Start SAL 8 HR96_Start SAL 8 HR97_Start SAL 8 HR98_Start SAL 8 HR99_Start SAL 8 HR100_Start SAL 8	HR26_Start HR Op HR27_Start HR Op HR28_Start HR Op HR29_Start HR Op HR30_Start HR Op HR31_Start HR Op HR32_Start HR Op HR33_Start HR Op HR34_Start HR Op HR35_Start HR Op HR36_Start HR Op HR37_Start HR Op HR38_Start HR Op HR39_Start HR Op HR40_Start HR Op HR41_Start HR Op 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@TES63_Start SAL 120 @TES64_Start SAL 124 @TES65_Start SAL 128 @TES66_Start SAL 132 @TES67_Start SAL 136 @TES68_Start SAL 140 @TES69_Start SAL 144 @TES70_Start SAL 148 @TES71_Start SAL 152 @TES72_Start SAL 156 @TES73_Start SAL 160 @TES74_Start SAL 164 @TES75_Start SAL 168 @TES76_Start SAL 172 @TES77_Start SAL 176 @TES78_Start SAL 180 @TES79_Start SAL 184 @TES80_Start SAL 188 @TES81_Start SAL 192 @TES82_Start SAL 196 @TES83_Start SAL 200 @TES84_Start SAL 204 @TES85_Start SAL 208 @TES86_Start SAL 212 @TES87_Start SAL 216 @TES88_Start SAL 220 @TES89_Start SAL 224 @TES90_Start SAL 228 @TES91_Start SAL 232 @TES92_Start SAL 236 @TES93_Start SAL 240 @TES94_Start SAL 244 @TES95_Start SAL 248 @TES96_Start SAL 252 @TES97_Start SAL 256 @TES98_Start SAL 260 @TES99_Start SAL 264 @TES100_Start SAL 268	HR45_SPI On HR46_SPI On HR47_SPI On HR48_SPI On HR49_SPI On HR50_SPI On HR51_SPI On HR52_SPI On HR53_SPI On HR54_SPI On HR55_SPI On HR56_SPI On HR57_SPI On HR58_SPI On HR59_SPI On HR60_SPI On HR61_SPI 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- Aura's Long Term Planning; Updates were made using Calendar edit page during the planning meeting. This was immediately reflected in the database



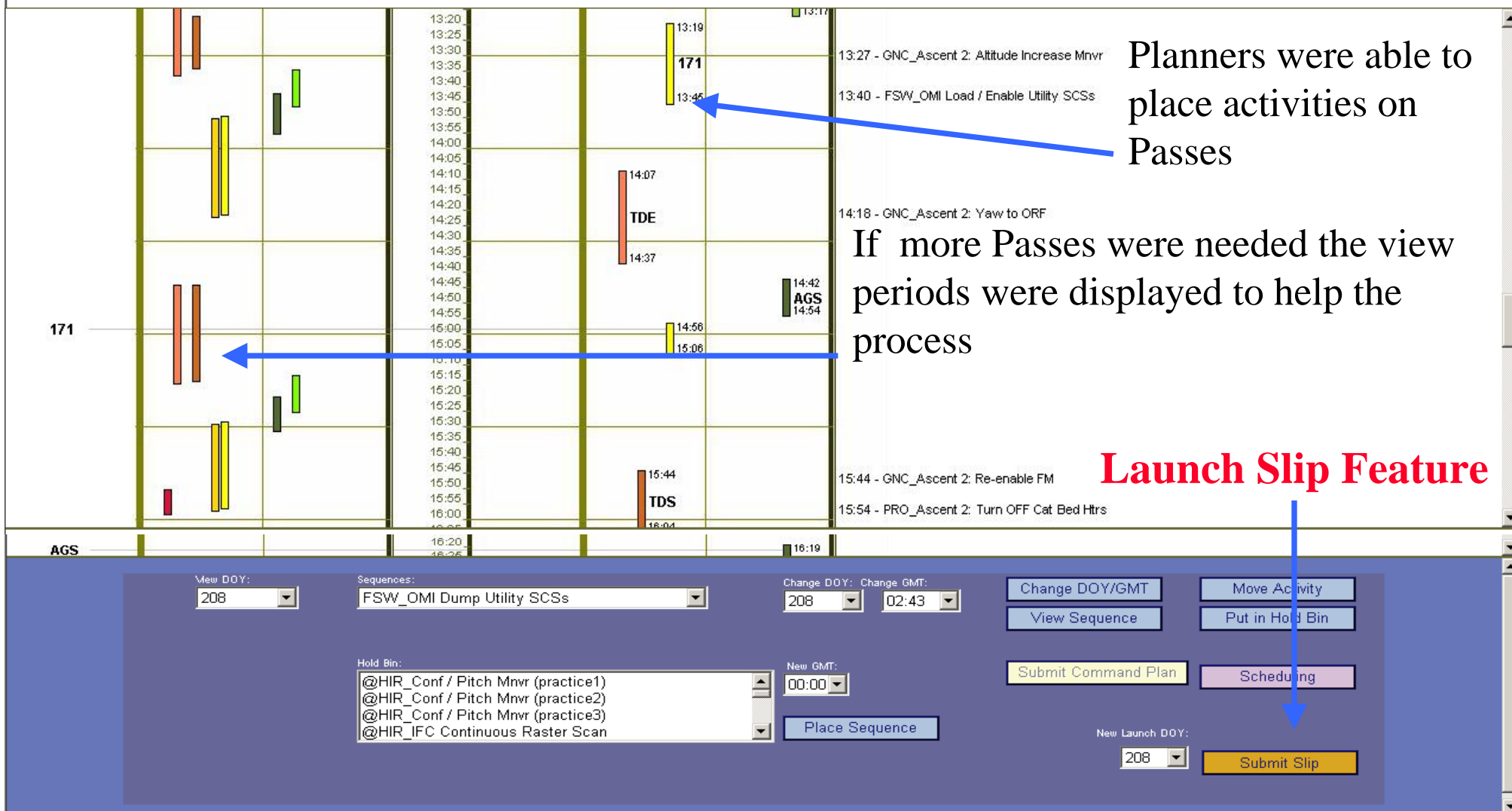
Daily Planning



sequence planner

DOY: 208

Daily Planning was now done in one step





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 be marked completed

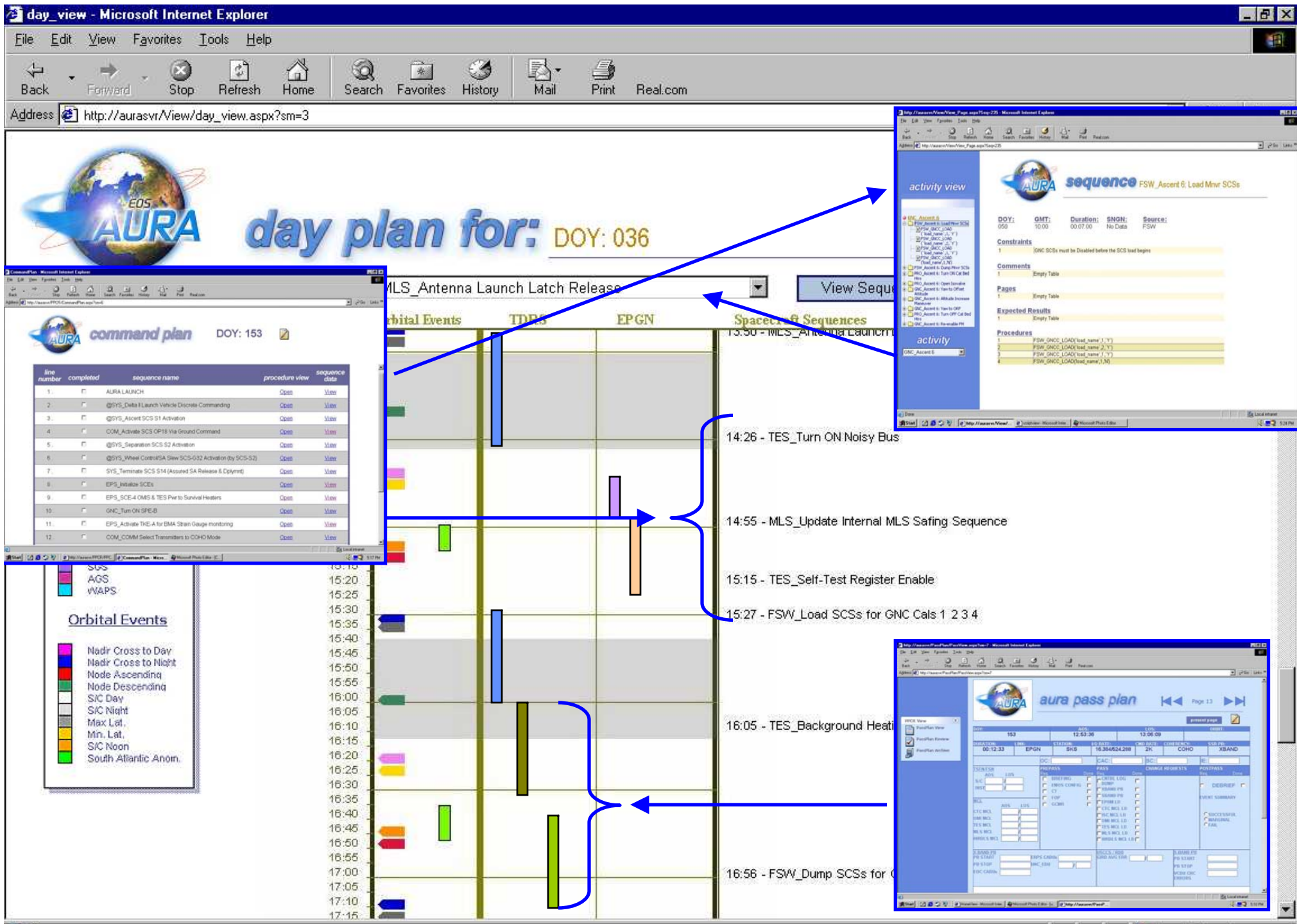
CR's will be required to
reorder activities

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

The Command Plan Links to
Proc and Sequence Details

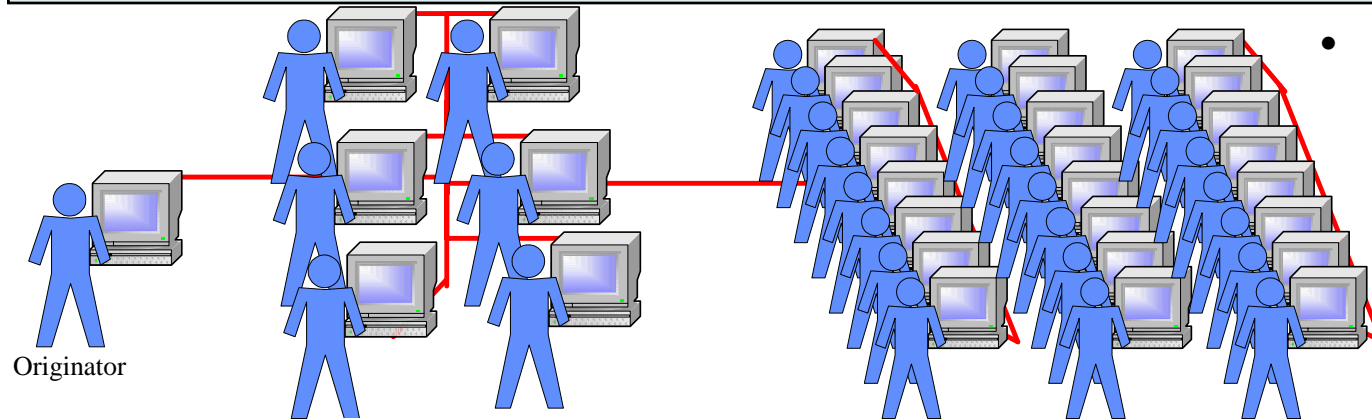
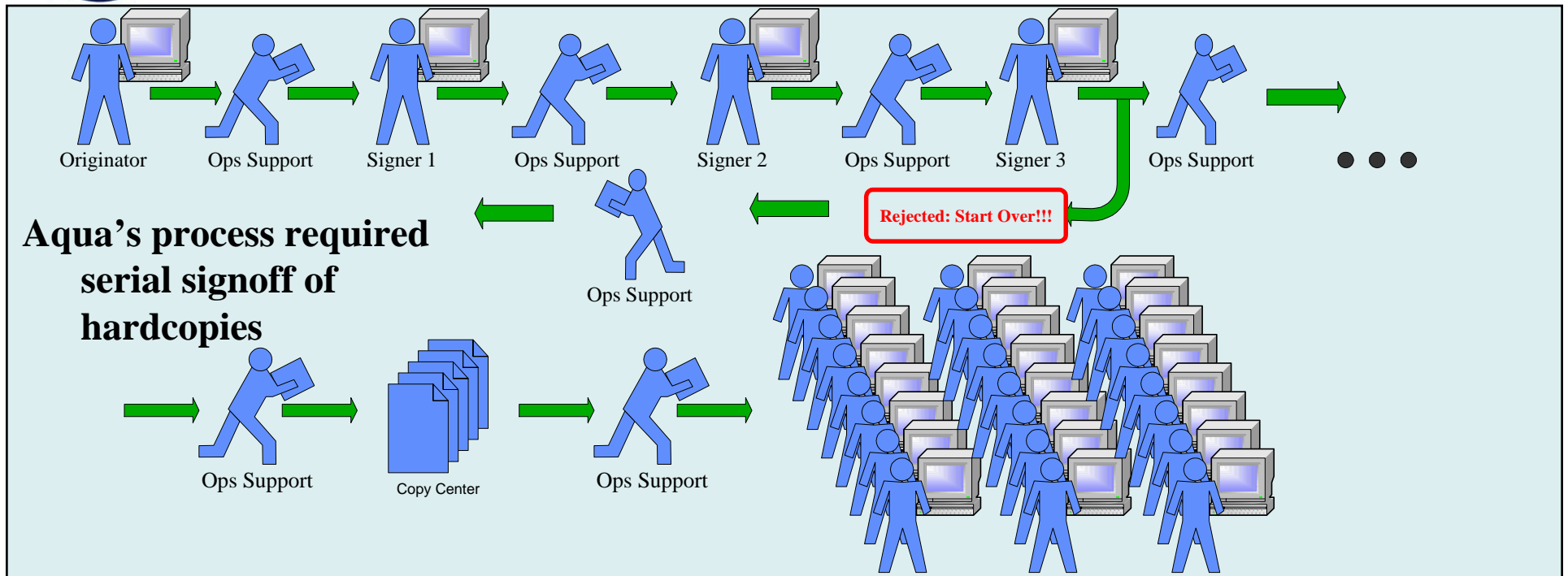
The screenshot shows the AURA command plan interface. At the top, there is a logo for AURA (Earth Observing Satellite) and the text "command plan". To the right, it says "DOY: 153". Below this is a table with the following columns: "line number", "completed", "sequence name", "procedure view", and "sequence data". The table contains 12 rows of activities. Each row has a checkbox in the "completed" column and two links in the "procedure view" and "sequence data" columns. Blue arrows point from the text annotations to specific elements in the table: one to the "completed" checkboxes, one to the "sequence name" column, and one to the "procedure view" and "sequence data" links.

line number	completed	sequence name	procedure view	sequence data
1.	<input type="checkbox"/>	AURA LAUNCH	Open	View
2.	<input type="checkbox"/>	@SYS_Delta II Launch Vehicle Discrete Commanding	Open	View
3.	<input type="checkbox"/>	@SYS_Ascend SCS S1 Activation	Open	View
4.	<input type="checkbox"/>	COM_Activate SCS OP18 Via Ground Command	Open	View
5.	<input type="checkbox"/>	@SYS_Separation SCS S2 Activation	Open	View
6.	<input type="checkbox"/>	@SYS_Wheel Control/SA Slew SCS-G22 Activation (by SCS-S2)	Open	View
7.	<input type="checkbox"/>	SYS_Terminate SCS S14 (Assured SA Release & Dplymnt)	Open	View
8.	<input type="checkbox"/>	EPS_Initialize SCES	Open	View
9.	<input type="checkbox"/>	EPS_SCE TOMIS & TES Pwr to Survival Heaters	Open	View
10.	<input type="checkbox"/>	GNC_Turn ON SPE-B	Open	View
11.	<input type="checkbox"/>	EPS_Activate TKE-A for BMA Strain Gauge monitoring	Open	View
12.	<input type="checkbox"/>	COM_COMM Select Transmitters to COHO Mode	Open	View





Electronic Signature



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



Ops Support

Signer Review in Parallel



Change Request Classes



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	Print
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	Print

on-deck

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

Severity	CR Num	CR Title	CR Type	Status
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

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

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	Pass Plan	N/A	N/A	rejected	View	Close	Print

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	<input type="checkbox"/>		Close

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

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

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



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.**