

TMT-APS Requirements Flow-down

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TMT-APS Requirements Flow-down

1 Introduction

We document the flow-down of all the Alignment and Phasing System (APS) requirements from their parents.

After the introduction, the requirements are shown by discipline and show only the requirement flow-down. The subsequent chapter has a single diagram for every requirement showing the parents, comments, and further attributes such as driving, key, verification method, and description.

The Appendices containing tables with the requirements. First, we start with a list of all the parents that are applicable to APS. Next are the APS requirements, which includes a list of the parent requirements. The third appendix is a table of requirements that are indicated to apply to APS; however, we don't believe that they are. Hence we propose removing that flag for these requirements. Finally, the last appendix shows the requirements we reject due to changes in the scope of either TMT or APS.

Note that for now, the introduction for now shows the flow-down process that we are following for the requirements. This can later be moved to an appendix.

2 Requirements Flowdown

Below are many diagrams documenting the flowdown of the parent to child requirement. Only the requirements are shown, with no extra attributes. Other attributes are shown in a later chapter.

When applicable, we also show the original TMT L1 document information, since sometimes the requirement text is not sufficient to figure out the requirement. This is at times because they are in tables, or because of Word document to DOORS importing issues.

3 Individual Requirements Views

3.1 APS Architecture Requirements

APS can't phase isolated segment groups

req [Package] APS Architecture Requirements[APS can't phase isolated segment groups]

«TMT Requirement»

Applicable Subsystems = APS, M1CS
Id = "6775"
Text = "[REQ-1-OAD-2225] The APS shall not be required to phase the M1 when there are groups of segments isolated from others."
TMT ID = "REQ-1-OAD-2225"
TMT ID = "REQ-1-OAD-2225"

Author: fdekens Version: 1.0
Modification Date: 9/5/23 5:03 PM Completion Status: DRAFT
Reviewed by:
Last Modified by: rkarban

APS commands

req [Package] APS Architecture Requirements[APS commands]

«TMT Requirement»

Applicable Subsystems = APS
Id = "6770"
Text = "[REQ-1-OAD-2200] The APS shall use starlight to measure the overall wavefront errors and then determine the appropriate commands to send to align the optics."
TMT ID = "REQ-1-OAD-2200"
TMT ID = "REQ-1-OAD-2200"

Author: fdekens Version: 1.0
Modification Date: 9/5/23 5:03 PM Completion Status: DRAFT
Reviewed by:
Last Modified by: rkarban

APS Starlight

req [Package] APS Architecture Requirements[APS Starlight]

«TMT Requirement»

Applicable Subsystems = APS
Id = "6770"
Text = "[REQ-1-OAD-2200] The APS shall use starlight to measure the overall wavefront errors and then determine the appropriate commands to send to align the optics."
TMT ID = "REQ-1-OAD-2200"
TMT ID = "REQ-1-OAD-2200"

«TMT Requirement»

Applicable Subsystems = APS
Id = "826"
Text = "[REQ-1-OAD-0170] The Alignment and Phasing system decomposition element is defined as follows:
Associated WBS element(s): TMT.TEL.CONT.APS
The Alignment and Phasing System (APS) is responsible for the rigid body alignment of the M1, M2 and M3, as well as adjusting the surface figure degrees of freedom for the M1. As part of the alignment process APS will have the capability to phase the 492 M1 segments. APS will use starlight to measure the wavefront errors and then will determine the appropriate corrections to align the optics.
The APS will align the telescope at various elevation angles and then from the set points for the M1, M2 and M3 control systems, lookup tables will be generated to correct for gravity-induced deformations. In a similar fashion, data will be collected at various temperatures over time and lookup tables will be built as a function of temperature as well. APS is not responsible for the generation of the LUTs.
APS includes all the necessary hardware, software, and interfaces (to the TCS; and M1, M2, and M3 control systems) required to accomplish the alignment tasks defined above.
APS will have an acquisition camera with a 1 to 2 arcminute field of view which can be used for telescope pointing, acquisition, and tracking tests. APS will also provide an optical port where a guider camera and a low order wavefront sensor can be placed in order to test its performance and to validate the active optics control algorithms.

problem»

What we really need here is a star magnitude. This should be derived from the ability to find a star withing some number of degrees from any specified Zenith angle

We are not required to use laser guide star light, because although that would let us place the star where we want it, the artificial star is too extended for use with our Shack Hartman phasing methods.

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
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| Last Modified by: rkarban | |

Incomplete Mirror

req [Package] APS Architecture Requirements[Incomplete Mirror]

«TMT Requirement»

Applicable Subsystems = APS, M1CS
Id = "16857"
Text = "[REQ-1-OAD-1100] The system shall operate with segments missing from the primary mirror or segments removed from the overall control loop."
TMT ID = "REQ-1-OAD-1100"
TMT ID = "REQ-1-OAD-1100"

«problem»

Should the above specify 25 arcseconds or the APS FoV?, Does this imply a requirement one level up?

| | |
|-----------------------------------|--------------------------|
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3.2 APS Environmental Requirements

Ambient Operating Temperature

req [Package] APS Environmental Requirements[Ambient Operating Temperature]

«TMT Requirement»

Applicable Subsystems = APS, ENC, IRIS, IRMS, LGSF, M1, M1CS, M2, M3, NFIRAOS, STR, SUM, PL&G, WFOS
Id = "14064"
Text = "[REQ-1-OAD-0010] All dimensions contained within this document apply when the sub-systems are at their expected steady state operating temperature during observing and the ambient temperature is equal to the median nighttime temperature for the site (T=275.3K)."
TMT ID = "REQ-1-OAD-0010"

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Complete loss of power

req [Package] APS Environmental Requirements§ Complete loss of power]

«TMT Requirement»

Id = "12669"
Text = "[REQ-1-OAD-4435] All equipment and sub-systems shall be able to withstand complete loss of power without sustaining damage or causing damage to other personnel and other equipment."
TMT ID = "REQ-1-OAD-4435"
TMT ID = "REQ-1-OAD-4435"

TMT Requirement attributes

«problem»

This assumes we have 1 min on UPS; however, we're missing that requirement, which is OAD-4430.

| | |
|-----------------------------------|--------------------------|
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| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
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Coolant Pressure

req [Package] APS Environmental Requirements§ Coolant Pressure]

«TMT Requirement»

Applicable Subsystems = APS, ENC, IRIS, IRMS, LGSF, M1CS, M2, M3, NFIRAOS, STR, SUM
Id = "12684"
Text = "[REQ-1-OAD-4670] The normal operating pressure of the coolant supplies listed in 'Table: Observatory coolant supply' above will be 5 bar."
TMT ID = "REQ-1-OAD-4670"
TMT ID = "REQ-1-OAD-4670"

APS Coolant Requirements

See this diagram for more information on this requirements.

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
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Coolant Temperatures

req [Package] APS Environmental Requirements§ Coolant Temperatures]

«TMT Requirement»

Applicable Subsystems = APS, ENC, IRIS, IRMS, LGSF, M1CS, M2, M3, NFIRAOS, STR, SUM
Id = "12681"
Text = "[REQ-1-OAD-4660] Coolant shall be supplied to the observatory at the temperatures defined in 'Table: Observatory coolant supply' below."
TMT ID = "REQ-1-OAD-4660"
TMT ID = "REQ-1-OAD-4660"

Text = "[OLE_AB_5051efba363412fb_23_2100000081_280000318b_e2aeee50-8ba7-4037-a066-fa435806be53_OBJECTTEXT_0.rtf](#)" OLE Object"



APS Coolant Requirements

See this diagram for more information on this requirements.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
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TMT Requirement attributes

Daylight Calibration

req [Package] APS Environmental Requirements§ Daylight Calibration]

«TMT Requirement»

Applicable Subsystems = NFIRAOS
Id = "12305"
Text = "[REQ-1-OAD-2707] Instruments shall be light tight to an extent that will allow internal calibrations to be performed during daytime operations with the enclosure lights on."
TMT ID = "REQ-1-OAD-2707"
TMT ID = "REQ-1-OAD-2707"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

TMT Requirement attributes

Glycol used at Nasmyth

req [Package] APS Environmental Requirements§ Glycol used at Nasmyth]

«TMT Requirement»

Applicable Subsystems = APS, IRIS, IRMS, NFIRAOOS, SUM
Id = "6404"
Text = "[REQ-1-OAD-4700] Chilled glycol coolant shall be provided to the Nasmyth areas for removal of heat from instrumentation and telescope control systems electronics."
TMT ID = "REQ-1-OAD-4700"
TMT ID = "REQ-1-OAD-4700"

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

 **APS Coolant Requirements**

See this diagram for more information on this requirements.

TMT Requirement attributes

Max Pressure Drop of Coolant

req [Package] APS Environmental Requirements§ Max Pressure Drop of Coolant]

«TMT Requirement»

Applicable Subsystems = APS, ENC, IRIS, IRMS, LGSF, M1CS, M2, M3, NFIRAOOS, STR, SUM
Id = "12685"
Text = "[REQ-1-OAD-4675] The maximum pressure drop through any single equipment heat exchanger shall be less than 1 bar."
TMT ID = "REQ-1-OAD-4675"
TMT ID = "REQ-1-OAD-4675"

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

 **APS Coolant Requirements**

See this diagram for more information on this requirements.

TMT Requirement attributes

Minimize Vibrations

req [Package] APS Environmental Requirements§ Minimize Vibrations]

«TMT Requirement»

Id = "11344"
Text = "[REQ-1-OAD-5504] All equipment at the summit observatory shall at minimum follow best engineering practices to minimize the production and transmission of vibrations onto the telescope."
TMT ID = "REQ-1-OAD-5504"
TMT ID = "REQ-1-OAD-5504"

TMT Requirement attributes

Author: fdekens

Version: 1.0

Modification Date: 9/5/23 5:03 PM

Completion Status: DRAFT

Reviewed by:

Last Modified by: rkarban

Observing Conditions

req [Package] APS Environmental Requirements: Observing Conditions]

| | | |
|-------------------|--|--|
| «TMT Requirement» | Id = "959" Text = "[REQ-1-ORD-1200] Unless otherwise stated, all requirements shall be met over the range of the Observing Performance Conditions. " TMT ID = "REQ-1-ORD-1210" TMT ID = "REQ-1-ORD-1210" | Tables 1 and 4.3 are not in the actual requirements, so if they change we will not know about it. They should either add the text in the requirement, or use a version number in the text, so we'll see a version increase if the table changes. |
|-------------------|--|--|

4.3 TEMPORAL TEMPERATURE GRADIENTS

Table 17 summarizes the night time temporal temperature gradients measured during the TMT site testing at Mauna Kea 13m from 29th June 2002 to 1st June 2003. The temperature gradients quoted are based on temperature values measured at 2m above ground level.

| Integration time (minutes) | min (°C) | 25% | 97.5% | max (°C) |
|----------------------------|----------|------|-------|----------|
| 1 | -24.1 | -9.4 | 9.4 | 67.0 |
| 4 | -30.6 | -15 | 5.3 | 50.9 |
| 8 | -16.9 | -3.4 | 3.2 | 13.6 |
| 16 | -9.6 | 2.2 | 2.0 | 7.2 |
| 32 | -0.8 | -1.5 | 1.2 | 3.7 |
| 60 | -3.7 | -1.1 | 0.7 | 2.1 |

This is Table 4.3 that the requirement is referring to in the ORD.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
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«problem»

We need L1 to be updated to include the r_{-0} seeing requirement, which I already added at L2.
We also need a separate requirement to function up to an r_{-0} of 13 cm (75% of the time) and the appropriate wind speed.

TMT Requirement attributes

3.3 APS Interface Requirements

APS at multiple Nasmyth locations

req [Package] APS Interface Requirements[APS at multiple Nasmyth locations]

↑«TMT Requirement»

Applicable Subsystems = APS
Id = "6506" | «Refines»
Text = "[REQ-1-OAD-1405] In order to facilitate early light configuration,
the APS system shall be moveable between the on and off
axis positions without reconfiguration of any early light
instruments."
TMT ID = "REQ-1-OAD-1405"
TMT ID = "REQ-1-OAD-1405"

«TMT Requirement»
«deprecated»

APS at multiple Nasmyth locations

Id = "REQ-2-APS-0010"
Text = "APS shall be able to operate at on and off axis
Nasmyth mounting positions."
TMT ID = "REQ-2-APS-0010"
TMT ID = "REQ-2-APS-0010"

Version: 1.0

| | |
|-----------------------------------|--------------------------|
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Backup Generator Power inside the Enclosure

req [Package] APS Interface Requirements[Backup Generator Power inside the Enclosure]

«TMT Requirement»

Applicable Subsystems = APS
Id = "13387"
Text = "[REQ-1-OAD-0911] Alignment and Phasing System (APS) 8.5 N/A 1.5 1.5
0.3 3.5 0.1 0.9 Computers on telescope None L1C L1CUG L3D"
TMT ID = "REQ-1-OAD-0911"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
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| Last Modified by: rkarban | |

See APS MEL/PEL spreadsheet for the assumptions going into this.

Backup Generator Power inside the Summit Facilities Building

req [Package] APS Interface Requirements| Backup Generator Power inside the Summit Facilities Building

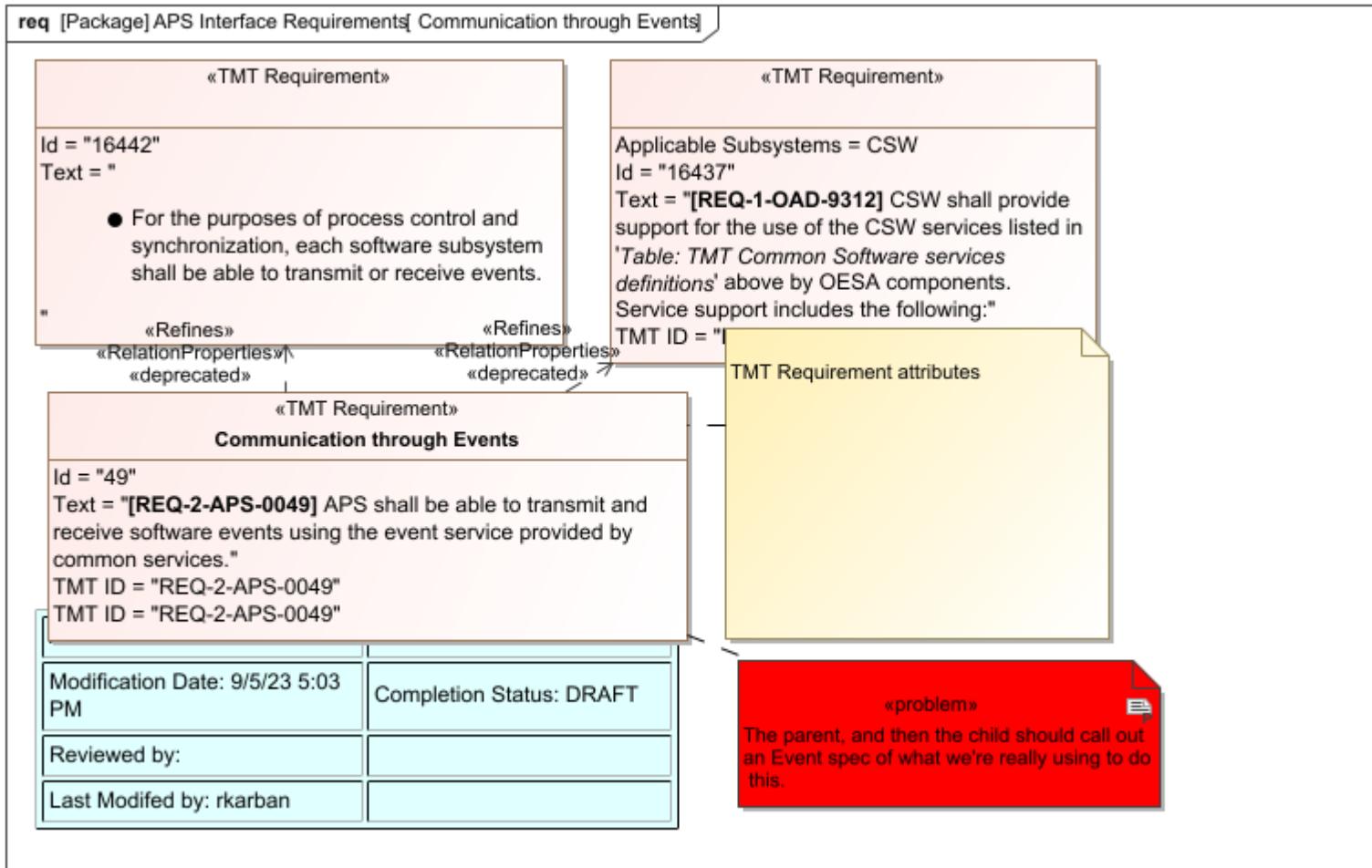
«TMT Requirement»

Applicable Subsystems = APS
Id = "14022"
Text = "[REQ-1-OAD-0952] Alignment and Phasing System
(APS) 4.2 N/A 4.2 4.2 1.0 0.0 1.0 0.0 All Computing None
L1CUG "
TMT ID = "REQ-1-OAD-0952"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Communication through Events



Daytime power to air inside the Summit Facilities Building

req [Package] APS Interface Requirements| Daytime power to air inside the Summit Facilities Building

«TMT Requirement»

Applicable Subsystems = APS
Id = "14022"
Text = "[REQ-1-OAD-0952] Alignment and Phasing System (APS) 4.2 N/A 4.2 4.2 1.0 0.0 1.0 0.0 All Computing None L1CUG "
TMT ID = "REQ-1-OAD-0952"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Daytime power to Glycol inside the Enclosure

req [Package] APS Interface Requirements| Daytime power to Glycol inside the Enclosure

«TMT Requirement»

Applicable Subsystems = APS
Id = "13387"
Text = "[REQ-1-OAD-0911] Alignment and Phasing System (APS) 8.5 N/A 1.5 1.5 0.3 3.5 0.1 0.9 Computers on telescope None L1C L1CUG L3D"
TMT ID = "REQ-1-OAD-0911"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Expected Annualized average power inside the Enclosure

req [Package] APS Interface Requirements| Expected Annualized average power inside the Enclosure]

«TMT Requirement»

Applicable Subsystems = APS
Id = "13387"
Text = "[REQ-1-OAD-0911] Alignment and Phasing System
(APS) 8.5 N/A 1.5 1.5 0.3 3.5 0.1 0.9 Computers on telescope
None L1C L1CUG L3D"
TMT ID = "REQ-1-OAD-0911"

TMT Requirement attributes

Author: fdekens

Version: 1.0

Modification Date: 9/5/23 5:03 PM

Completion Status: DRAFT

Reviewed by:

Last Modified by: rkarban

Expected Annualized average power inside the Summit Facilities Building

req [Package] APS Interface Requirements| Expected Annualized average power inside the Summit Facilities Building

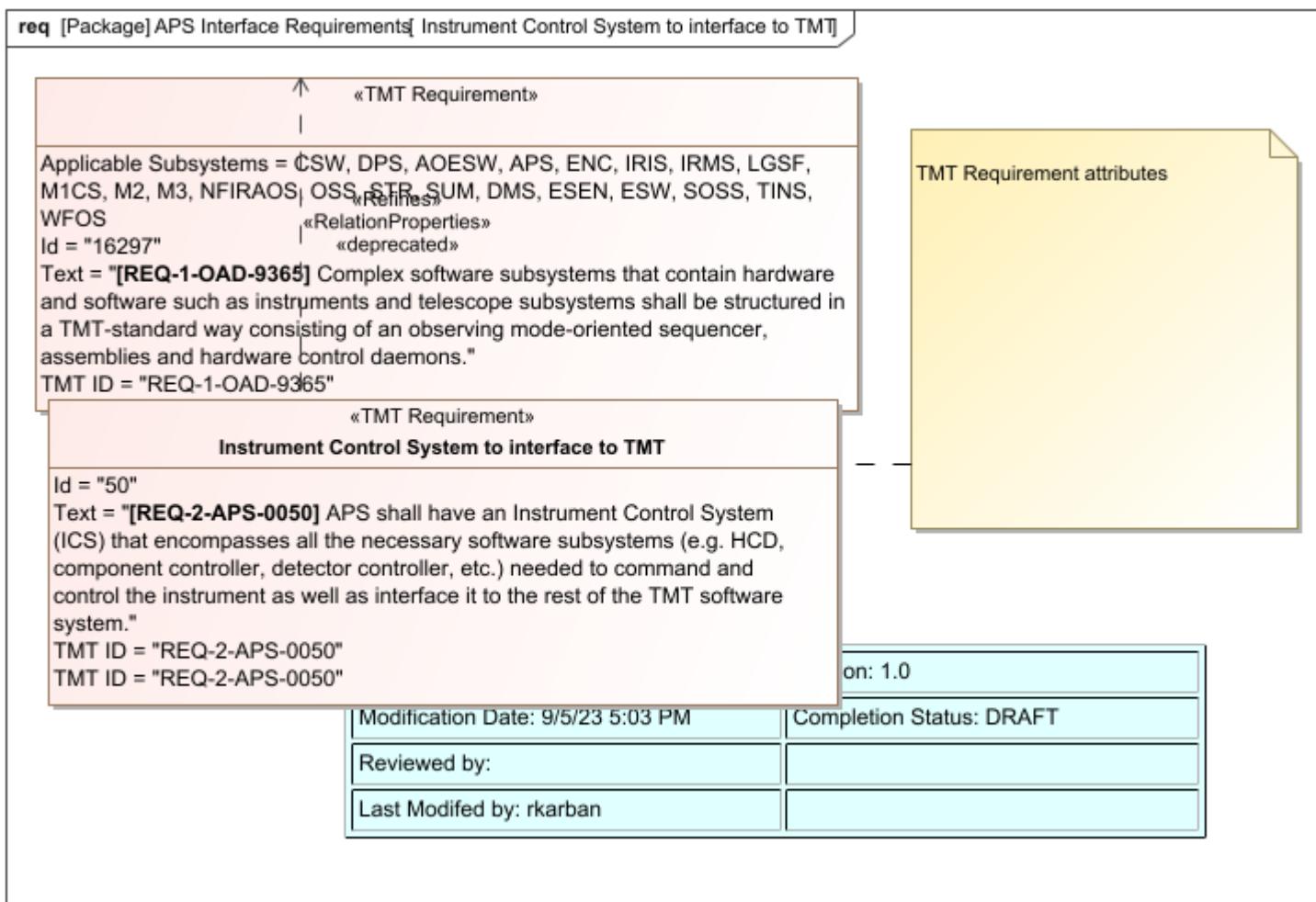
«TMT Requirement»

Applicable Subsystems = APS
Id = "14022"
Text = "[REQ-1-OAD-0952] Alignment and Phasing System (APS) 4.2 N/A
4.2 4.2 1.0 0.0 1.0 0.0 All Computing None L1CUG "
TMT ID = "REQ-1-OAD-0952"

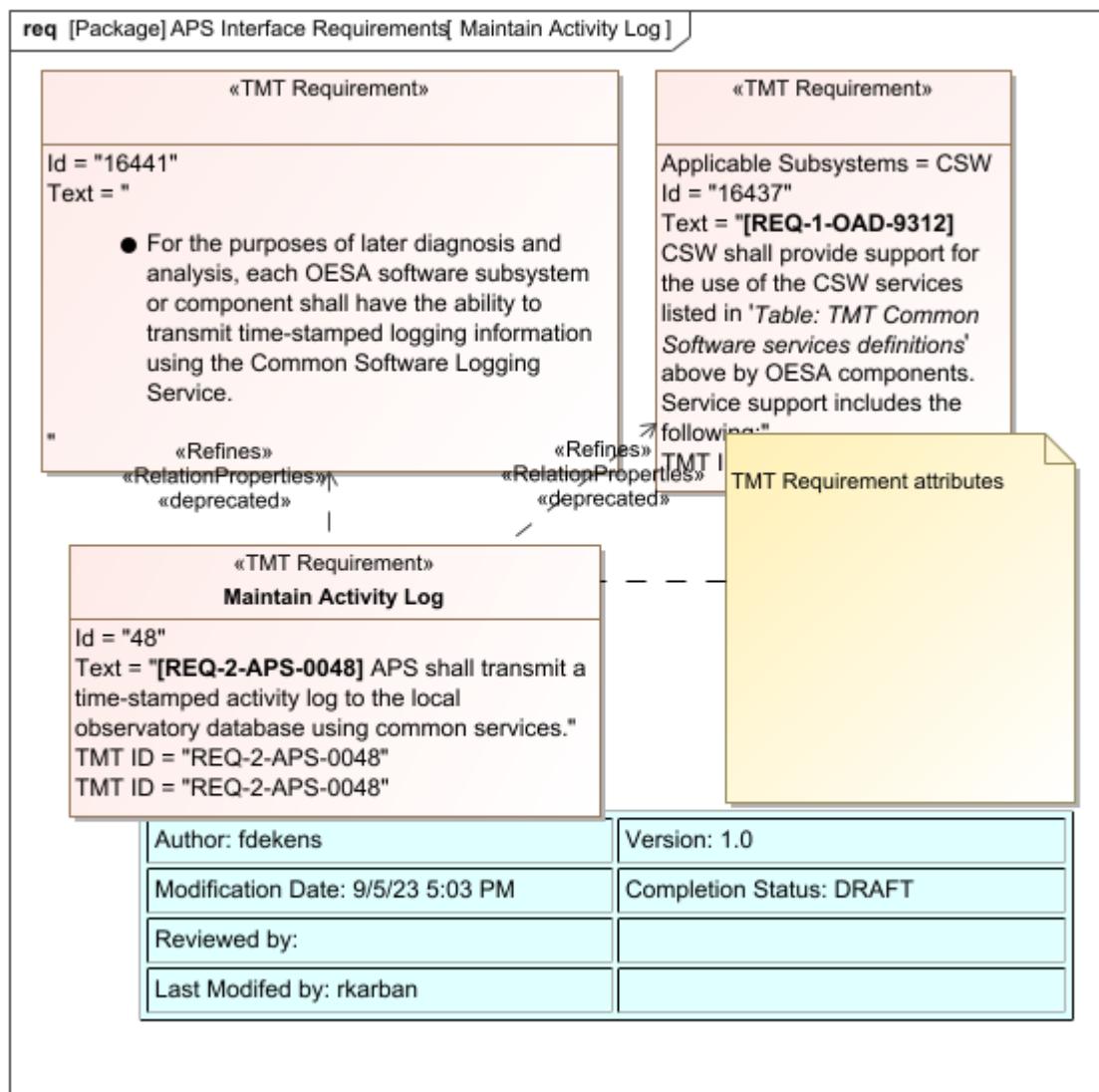
TMT Requirement attributes

| | |
|--------------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
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Instrument Control System to interface to TMT



Maintain Activity Log



Mass Allocation: Electronics and Misc

req [Package] APS Interface Requirements[Mass Allocation: Electronics and Misc]

«TMT Requirement»

Applicable Subsystems = APS
Id = "15361"
Text = "[REQ-1-OAD-0750] APS Alignment and Phasing System 6.0 6.0
TMT.INS.TEC.07.004.DRF01
<<http://docushare.tmt.org/docushare/dsweb/Get/Document-8642/>>"
TMT ID = "REQ-1-OAD-0750"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Mass Allocation: Instrument

req [Package] APS Interface Requirements[Mass Allocation: Instrument]

«TMT Requirement»

Applicable Subsystems = APS
Id = "15361"
Text = "[REQ-1-OAD-0750] APS Alignment and Phasing System 6.0 6.0
TMT.INS.TEC.07.004.DRF01
<<http://docushare.tmt.org/docushare/dsweb/Get/Document-8642/>>"
TMT ID = "REQ-1-OAD-0750"

TMT Requirement attributes

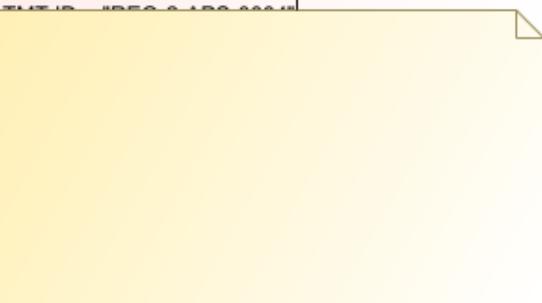
| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

N²

req [Package] APS Interface Requirements| N²]

«TMT Requirements»
«deprecated»

Id = "REQ-2-APS-0004"
Text = "APS shall comply with the interface documents specified in the [AD15] TMT Interface N² Diagram."
TMT ID = "REQ-2-APS-0004"



«problem»

We now also have one requirement per ICD interface; so we should remove this and link the ICD ones to this parent.



Author: fdekens

Version: 1.0

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Completion Status: DRAFT

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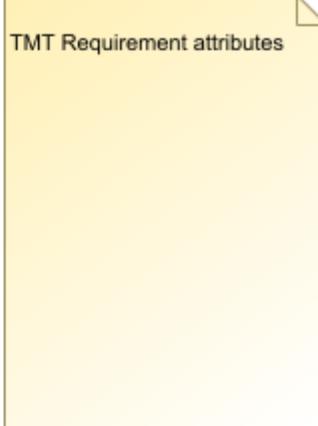
Last Modified by: rkarban

Nighttime power to air inside the Summit Facilities Building

req [Package] APS Interface Requirements| Nighttime power to air inside the Summit Facilities Building]

«TMT Requirements»

Applicable Subsystems = APS
Id = "14022"
Text = "[REQ-1-OAD-0952] Alignment and Phasing System (APS) 4.2 N/A 4.2 4.2 1.0 0.0 1.0 0.0 All Computing None L1CUG "
TMT ID = "REQ-1-OAD-0952"



TMT Requirement attributes



Author: fdekens

Version: 1.0

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Completion Status: DRAFT

Reviewed by:

Last Modified by: rkarban

Peak Power inside the Enclosure

req [Package] APS Interface Requirements| Peak Power inside the Enclosure]

«TMT Requirement»

Applicable Subsystems = APS
Id = "13387"
Text = "[REQ-1-OAD-0911] Alignment and Phasing System (APS) 8.5 N/A 1.5 1.5 0.3 3.5 0.1 0.9 Computers on telescope None L1C L1CUG L3D"
TMT ID = "REQ-1-OAD-0911"

Author: fdekens Version: 1.0
Modification Date: 9/5/23 5:03 PM Completion Status: DRAFT
Reviewed by:
Last Modified by: rkarban

Peak Power inside the Summit Facilities Building

req [Package] APS Interface Requirements| Peak Power inside the Summit Facilities Building]

«TMT Requirement»

Applicable Subsystems = APS
Id = "14022"
Text = "[REQ-1-OAD-0952] Alignment and Phasing System (APS) 4.2 N/A 4.2 4.2 1.0 0.0 1.0 0.0 All Computing None L1CUG "
TMT ID = "REQ-1-OAD-0952"

Author: fdekens Version: 1.0
Modification Date: 9/5/23 5:03 PM Completion Status: DRAFT
Reviewed by:
Last Modified by: rkarban

Power Distribution

req [Package] APS Interface Requirements[Power Distribution]

«TMT Requirement»

Id = "12658"
Text = "[REQ-1-OAD-4400] Electrical power shall be distributed to the summit facilities, enclosure, telescope and sub-systems as defined in 'Table: Power types delivered to enclosure, telescope and telescope mounted equipment and sub-systems' below . "
TMT ID = "REQ-1-OAD-4400"
TMT ID = "REQ-1-OAD-4400"

TMT Requirement attributes

«problem»

The parent is not in sync with the OAD (v26), but I already updated our APS requirement to reflect it. We should really copy over the actual interface spec in here instead of referring to the OAD table, once that's specified.

| | |
|-----------------------------------|--------------------------|
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| Last Modified by: rkarban | |

UPC Power inside the Enclosure

req [Package] APS Interface Requirements[UPC Power inside the Enclosure]

«TMT Requirement»

Applicable Subsystems = APS
Id = "13387"
Text = "[REQ-1-OAD-0911] Alignment and Phasing System (APS) 8.5 N/A 1.5 1.5 0.3 3.5 0.1 0.9 Computers on telescope None L1C L1CUG L3D"
TMT ID = "REQ-1-OAD-0911"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

See APS MEL/PEL spreadsheet for the assumptions going into this.

UPC Power inside the Summit Facilities Building

req [Package] APS Interface Requirements[UPC Power inside the Summit Facilities Building]

«TMT Requirement»

Applicable Subsystems = APS
Id = "14022"
Text = "[REQ-1-OAD-0952] Alignment and Phasing System
(APS) 4.2 N/A 4.2 4.2 1.0 0.0 1.0 0.0 All Computing None
L1CUG "
TMT ID = "REQ-1-OAD-0952"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Volume Allocation: Bench

req [Package] APS Interface Requirements[Volume Allocation: Bench]

«TMT Requirement»

Applicable Subsystems = APS
Id = "11309"
Text = "APS See drawing [TMT.TEL.CONT.APS-ENV](#)
<<https://docushare.tmt.org/docushare/dsweb/Get/Document-17976/TMT.TEL.CONT.APS-ENV.pdf>>
right hand face
(viewed from I

«TMT Requirement»

Applicable Subsystems = APS, IRIS, IRMS, NFIRAO, STR
Id = "6514"
Text = "[REQ-1-OAD-1425] Instruments shall not exceed the volumes, and shall meet the focal plane
position requirements listed in 'Table: Instrument Volumes and Associated Electronics' below."
TMT ID = "REQ-1-OAD-1425"
TMT ID = "REQ-1-OAD-1425"

TMT Requirement attributes

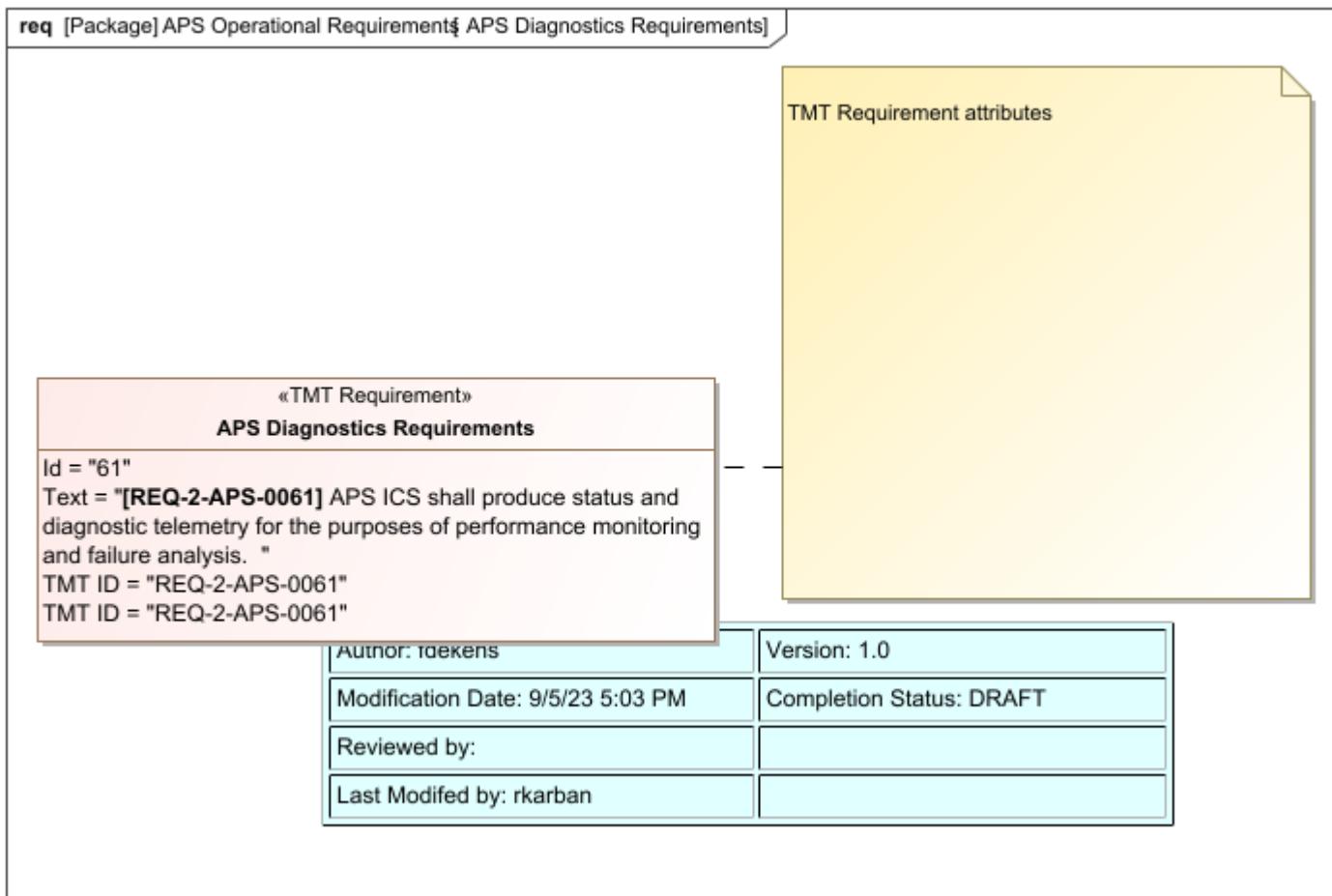
| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

«problem»

The parent needs to be fixed, since it refers to the wrong table,
and should refer to this document.

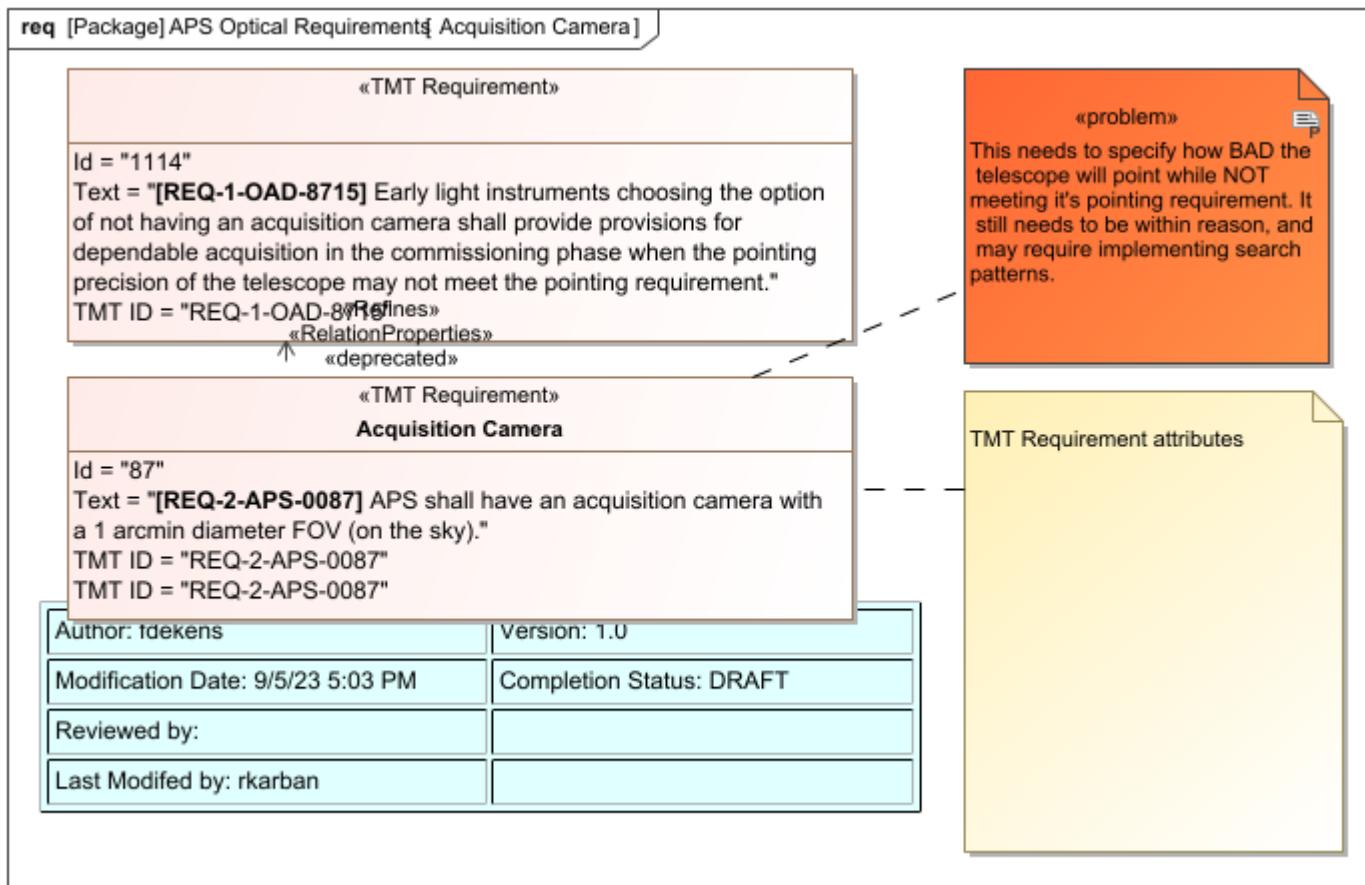
3.4 APS Operational Requirements

APS Diagnostics Requirements

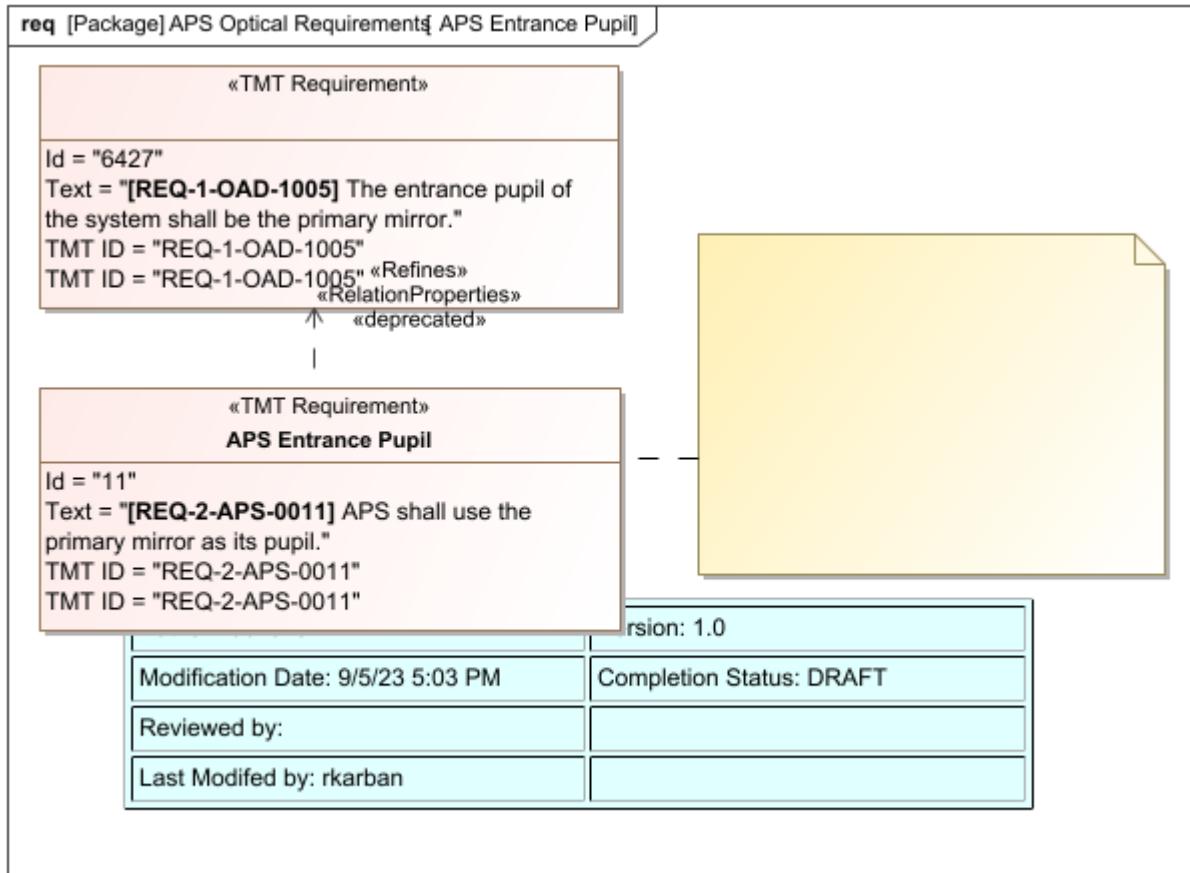


3.5 APS Optical Requirements

Acquisition Camera



APS Entrance Pupil



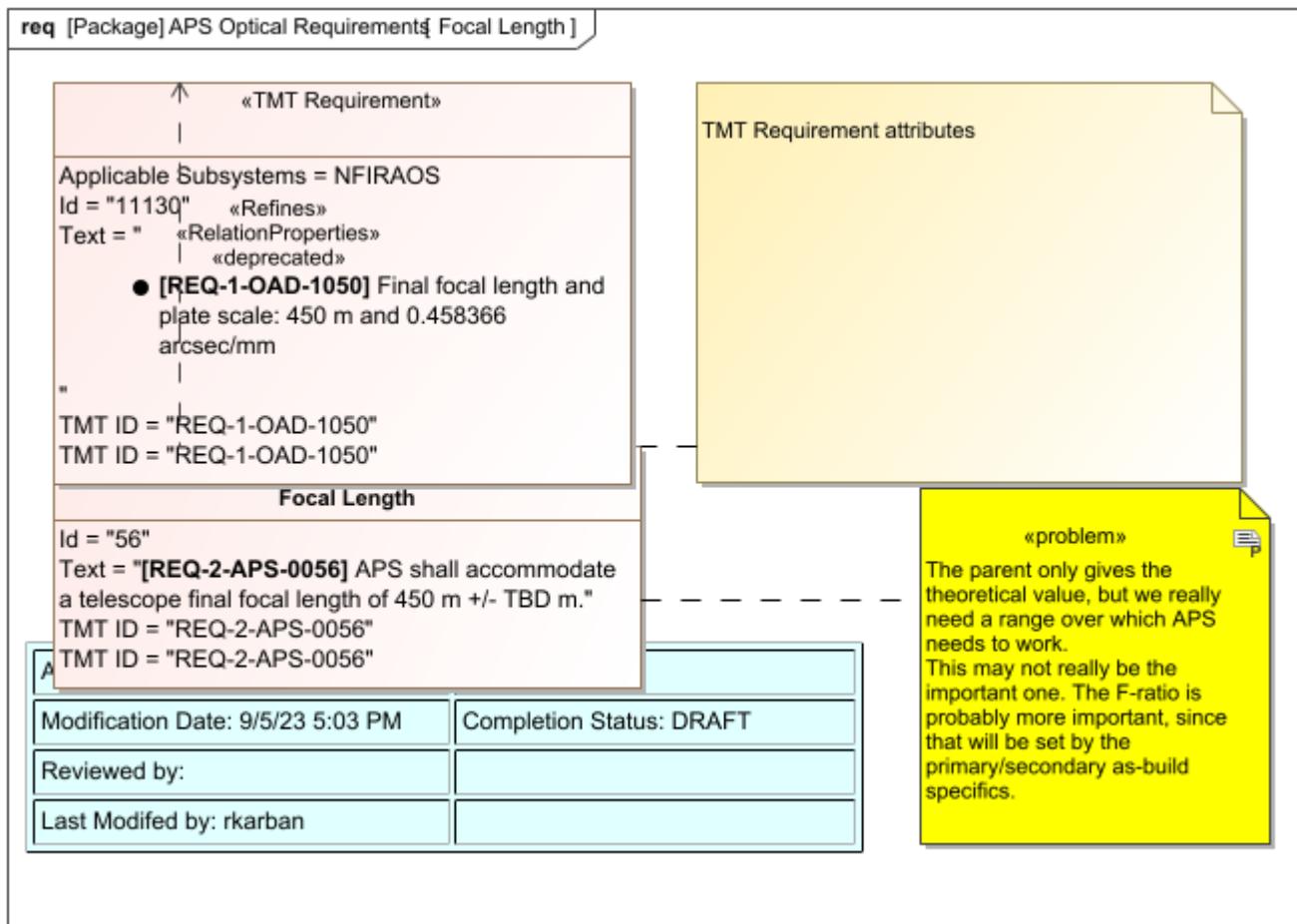
APS Hazard Analysis and Safety Practices

req [Package] APS Optical Requirements§ APS Hazard Analysis and Safety Practices]

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Focal Length



Perform Maintenance while on Nasmyth platform

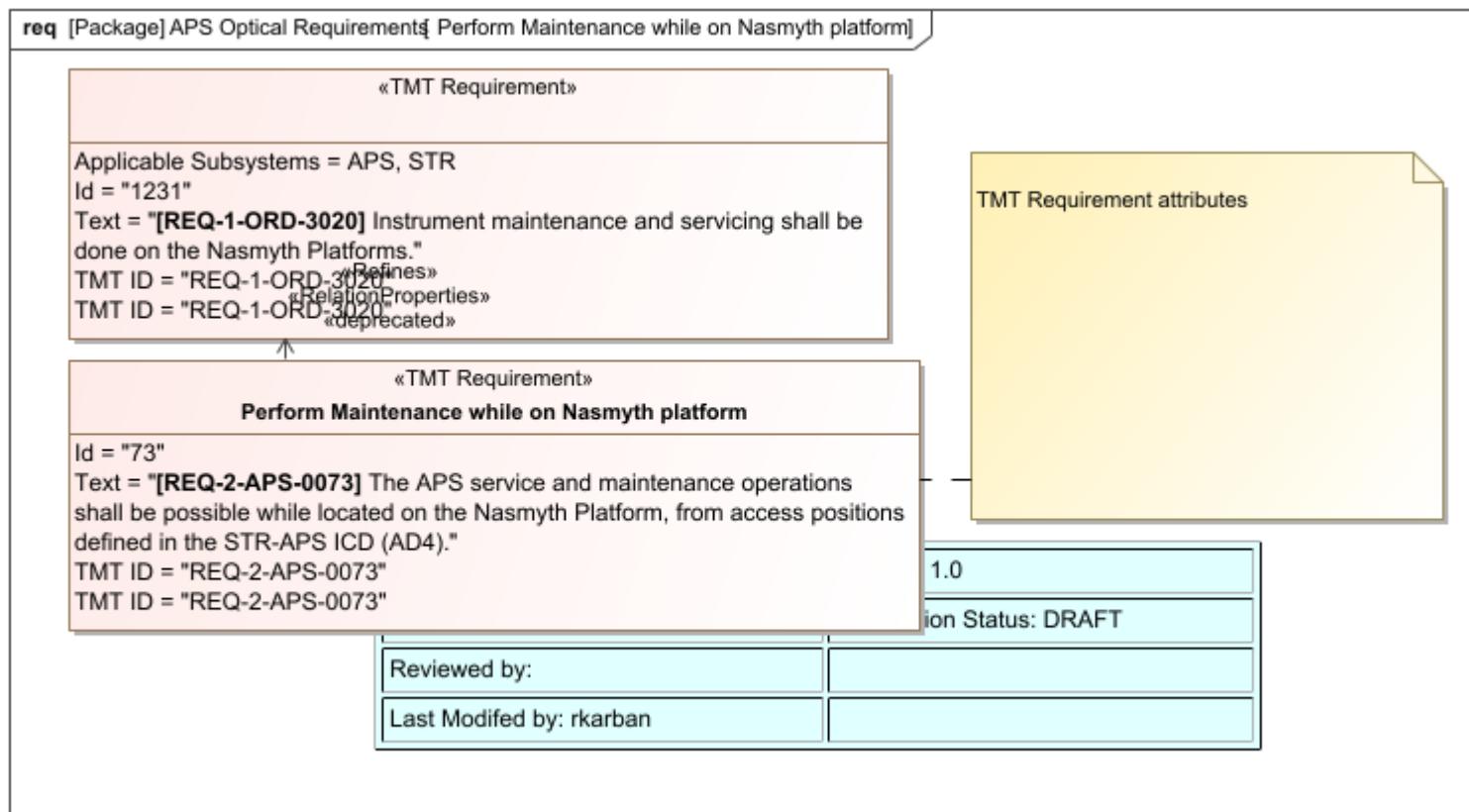
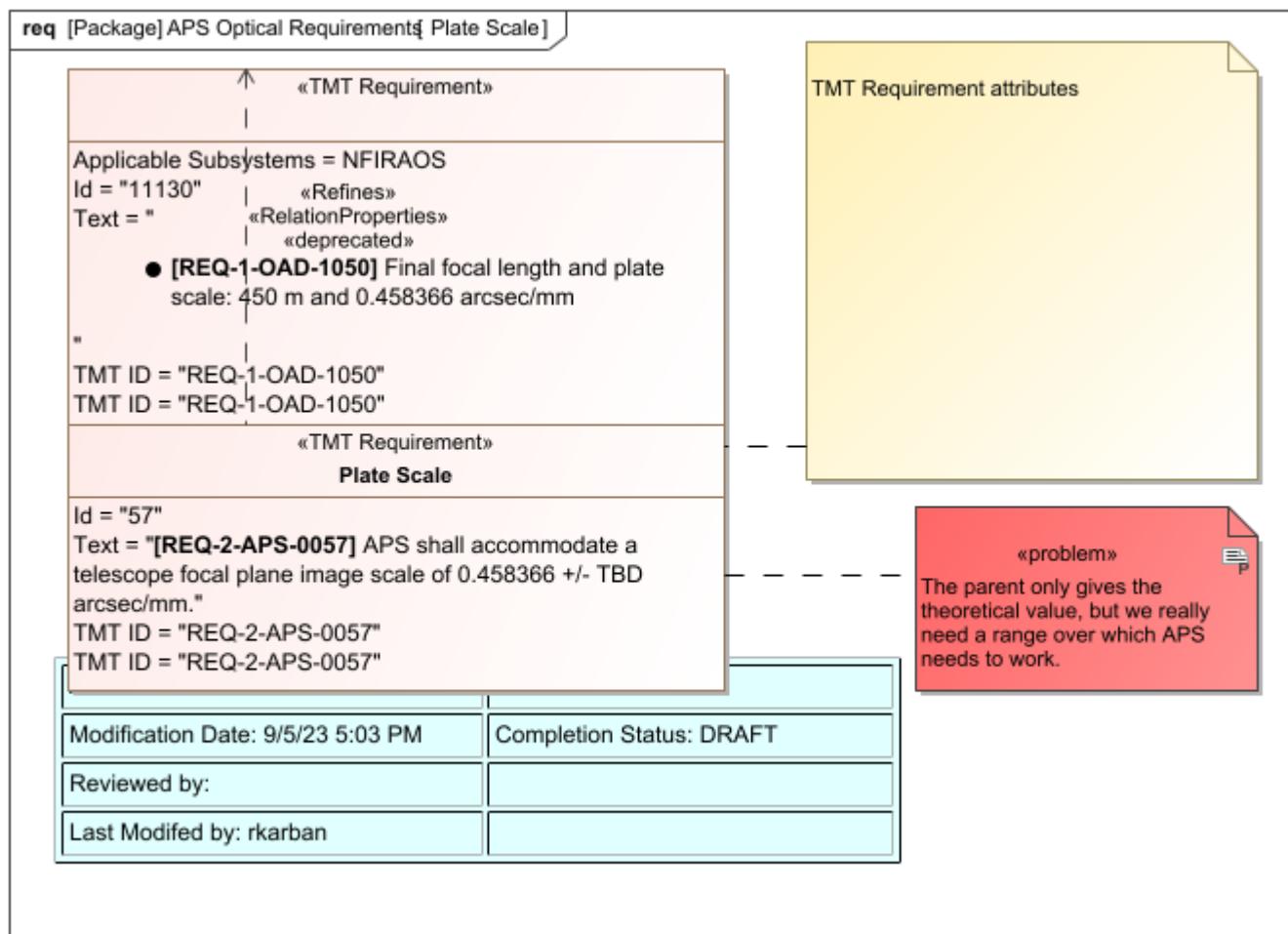
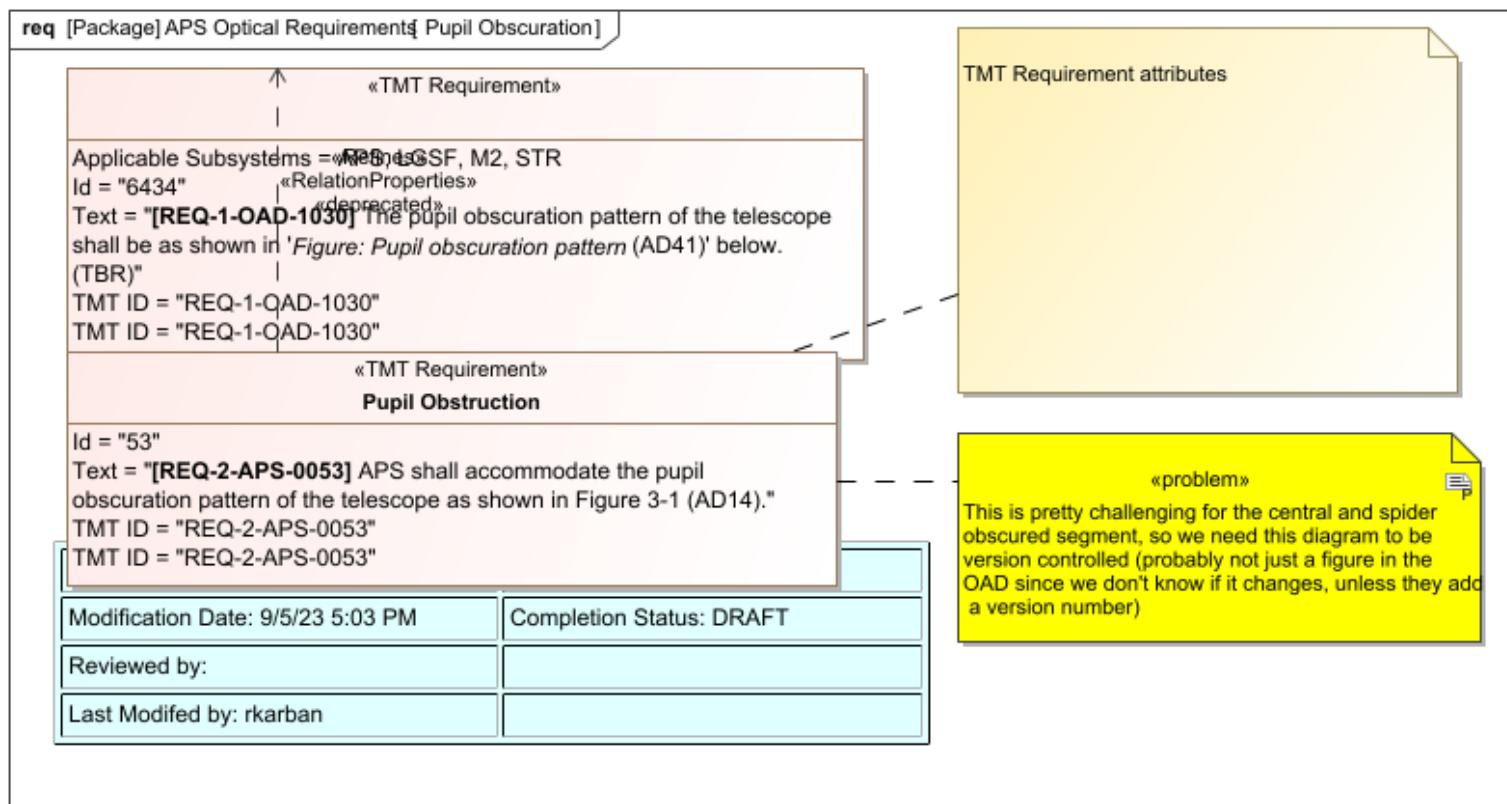


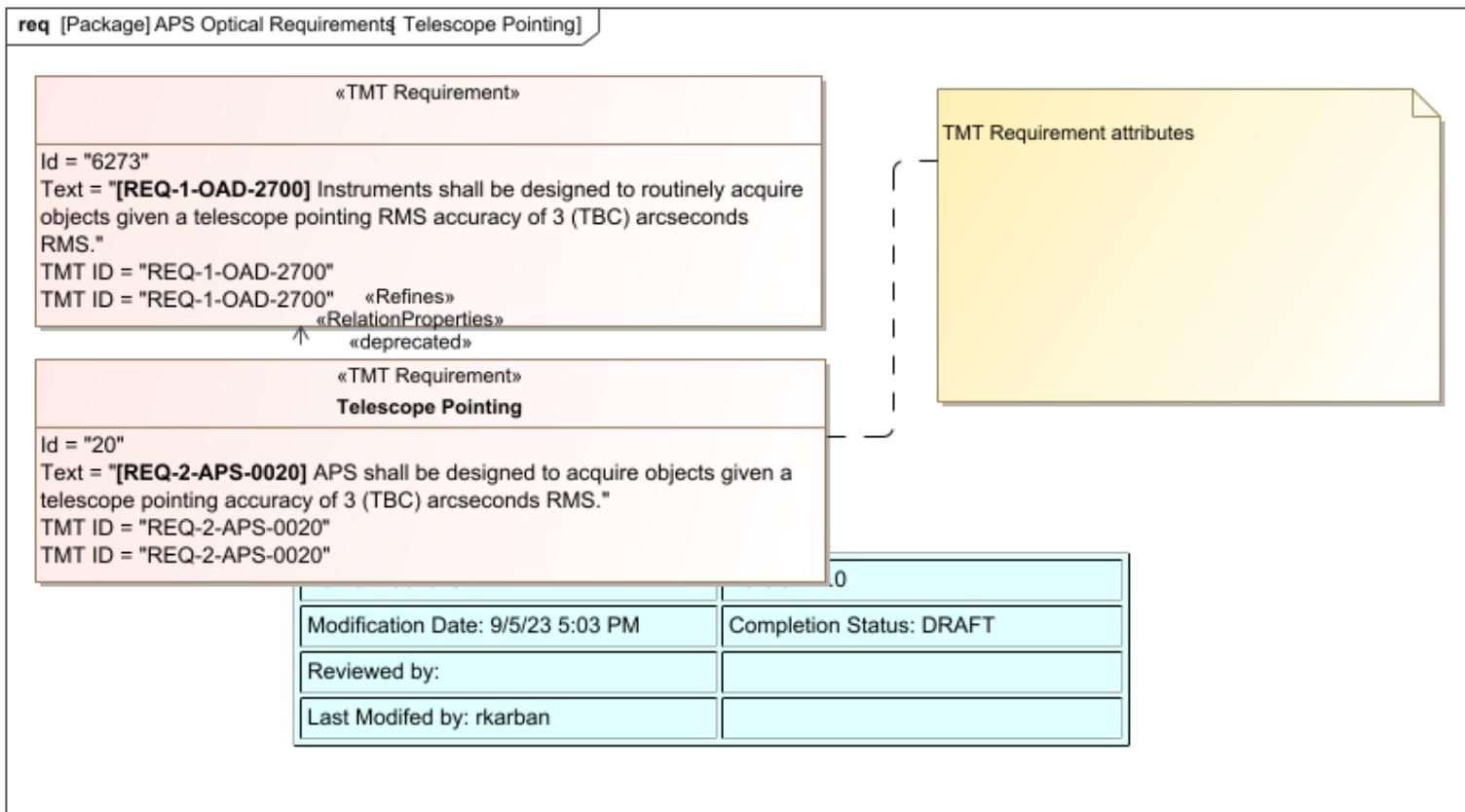
Plate Scale



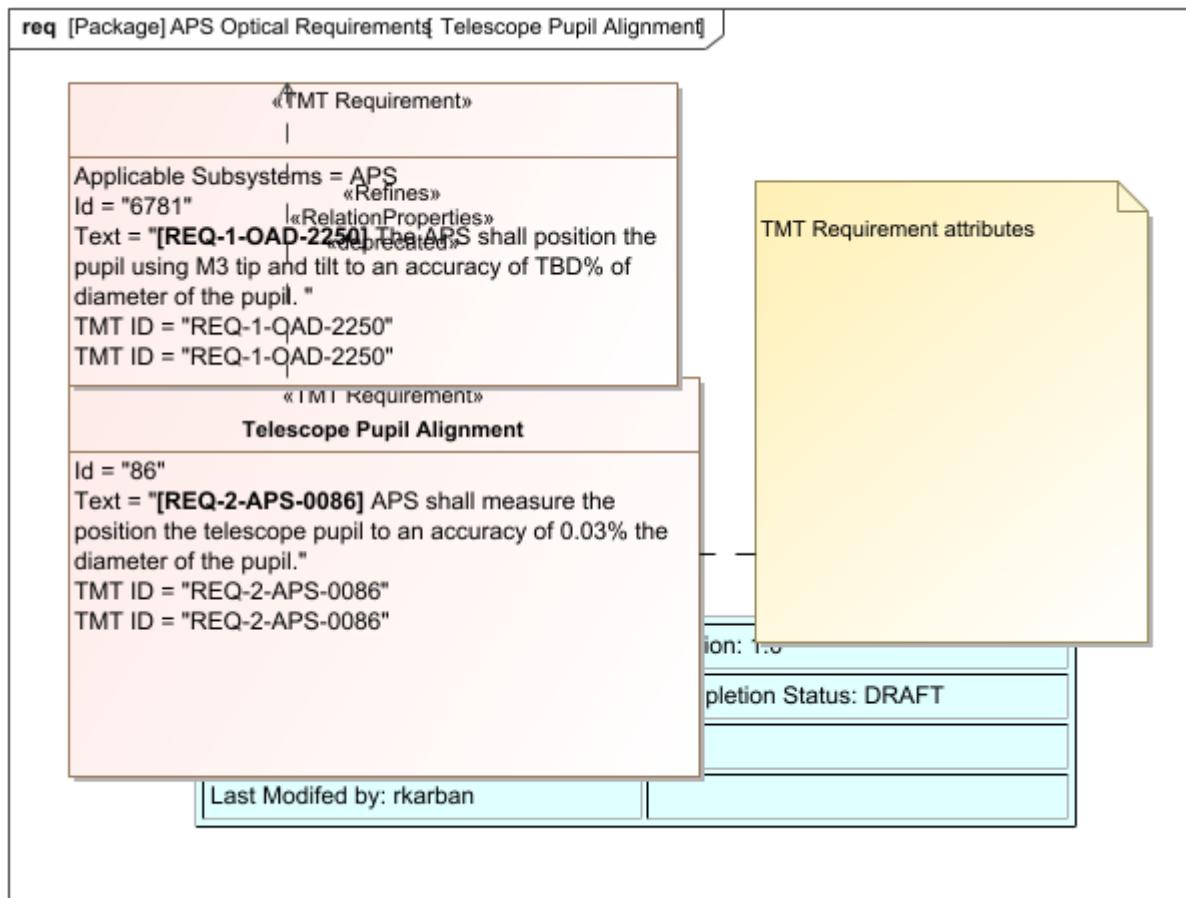
Pupil Obscuration



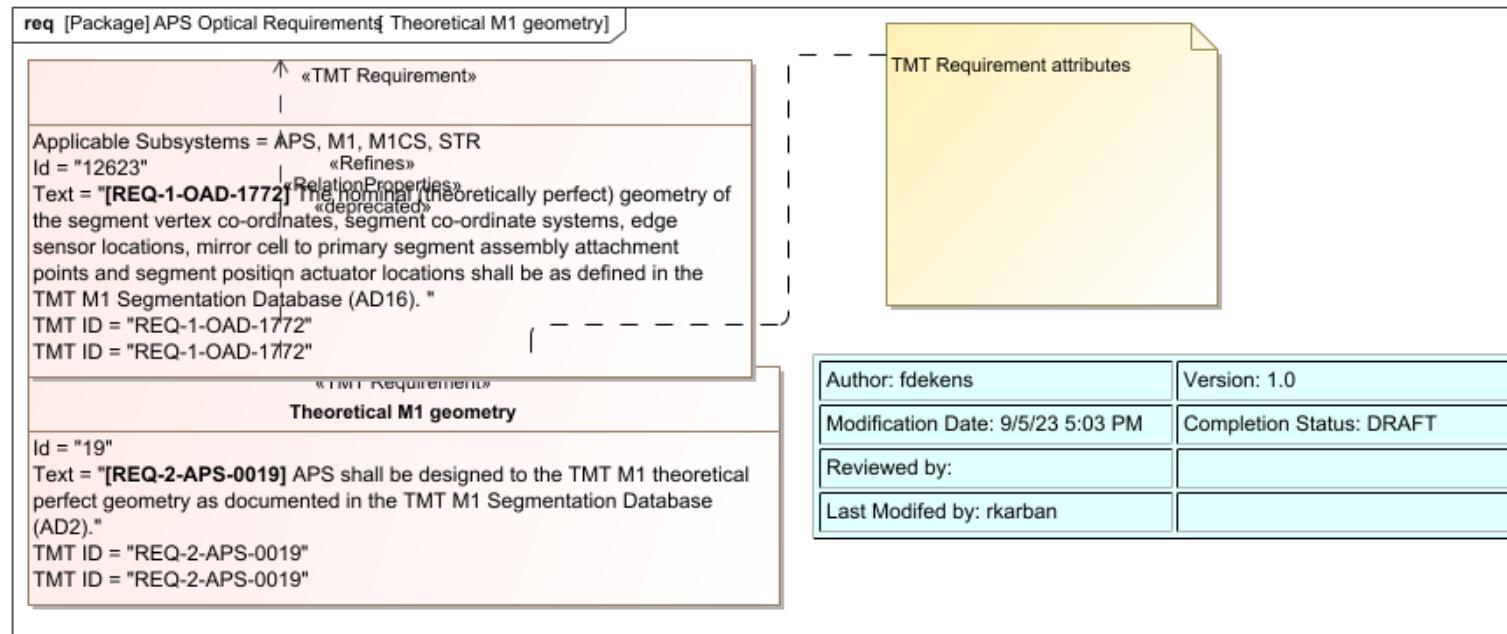
Telescope Pointing



Telescope Pupil Alignment



Theoretical M1 geometry

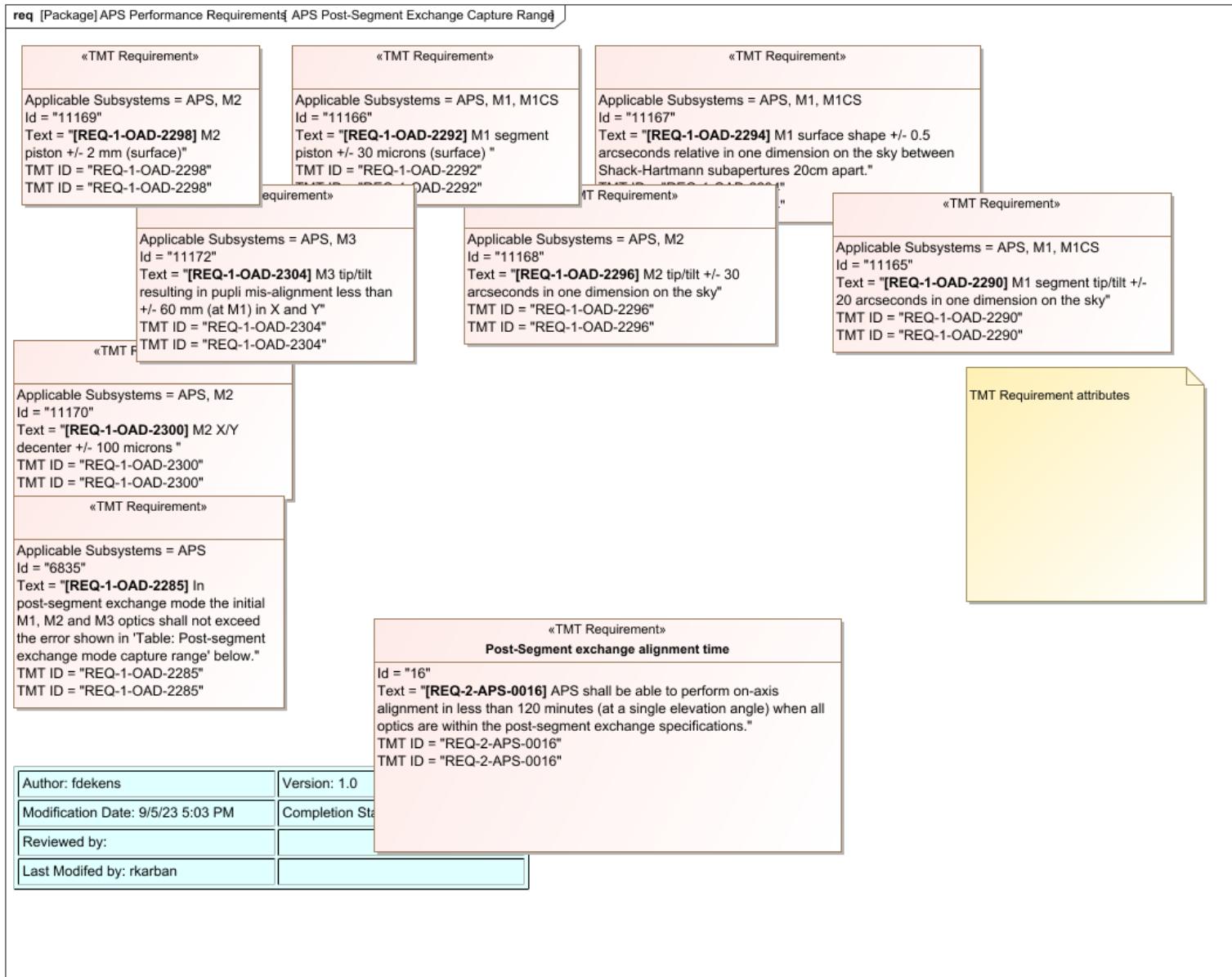


3.6 APS Performance Requirements

APS Maintenance Alignment Capture Range

| req [Package] APS Performance Requirements APS Maintenance Alignment Capture Range | | |
|--|--|--|
| «TMT Requirement» | «TMT Requirement» | «TMT Requirement» |
| Applicable Subsystems = APS, M1, M1CS Id = "11157" Text = "[REQ-1-OAD-2264] M1 surface shape +/- 0.25 arcseconds relative in one dimension on the sky between Shack-Hartmann subapertures 20cm apart." TMT ID = "REQ-1-OAD-2264" TMT ID = "REQ-1-OAD-2264" | Applicable Subsystems = APS Id = "6782" Text = "[REQ-1-OAD-2255] In alignment maintenance mode the initial M1, M2 and M3 optics shall not exceed the error shown in 'Table: Alignment maintenance mode capture range' below." TMT ID = "REQ-1-OAD-2255" | Applicable Subsystems = APS, M2 Id = "11160" Text = "[REQ-1-OAD-2270] M2 X/Y decenter +/- 100 microns " TMT ID = "REQ-1-OAD-2270" TMT ID = "REQ-1-OAD-2270" |
| Applicable Subsystems = APS, M1CS Id = "11155" Text = "[REQ-1-OAD-2260] M1 segment tip/tilt +/- 10 arcseconds in one dimension on the sky" TMT ID = "REQ-1-OAD-2260" TMT ID = "REQ-1-OAD-2260" | " | Applicable Subsystems = APS, M2 Id = "11158" Text = "[REQ-1-OAD-2266] M2 tip/tilt +/- 30 arcseconds in one dimension on the sky" TMT ID = "REQ-1-OAD-2266" TMT ID = "REQ-1-OAD-2266" |
| «TMT Requirement» | «TMT Requirement» | «TMT Requirement» |
| Applicable Subsystems = APS, M1CS Id = "11156" Text = "[REQ-1-OAD-2262] M1 segment piston +/- 110 nm (surface)" TMT ID = "REQ-1-OAD-2262" | | |
| «TMT Requirements» | «TMT Requirement» | «TMT Requirement» |
| Applicable Subsystems = APS, M2 Id = "11159" Text = "[REQ-1-OAD-2268] M2 piston +/- 2 mm (surface)" TMT ID = "REQ-1-OAD-2268" | Alignment Maintenance time | TMT Requirement attributes |
| «TMT Requirements» | Id = "17" Text = "[REQ-2-APS-0017] APS shall be able to perform on-axis alignment in less than 30 minutes (at a single elevation angle) when all optics are within the alignment maintenance specifications." TMT ID = "REQ-2-APS-0017" TMT ID = "REQ-2-APS-0017" | |
| Applicable Subsystems = APS, M3 Id = "11162" Text = "[REQ-1-OAD-2274] M3 tip/tilt resulting in pupil mis-alignment less than +/- 60 mm (at M1) in X and Y" TMT ID = "REQ-1-OAD-2274" TMT ID = "REQ-1-OAD-2274" | | |
| Modification Date: 9/23 5:03 PM | Completion Status: DRAFT | |
| Reviewed by: | | |
| Last Modified by: rkarban | | |

APS Post-Segment Exchange Capture Range



Off-Axis measurements

req [Package] APS Performance Requirements| Off-Axis measurements]

«TMT Requirement»

Applicable Subsystems = APS
Id = "6780"
Text = "[REQ-1-OAD-2245] The APS shall have the ability to make off axis measurements at any point in the telescope field of view and characterize the wavefront in terms of Zernikes."
TMT ID = "REQ-1-OAD-2245"
TMT ID = "REQ-1-OAD-2245"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Segment Measurement Error

req [Package] APS Performance Requirements| Segment Measurement Error

«TMT Requirement»

Applicable Subsystems = APS
Id = "16887"
Text = "[REQ-1-OAD-0462]
M1 warping harness wavefront measurement error
Error allocation: 0.9896
Wavefront Error Allocation after AO (NFIRAOS) Correction (nm rms): 11.7

"
TMT ID = "REQ-1-OAD-0462"



APS Performance Requirements: M1 Segments

See here for more info on the flow down of this requirement.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Segment out-of-plane residual error

req [Package] APS Performance Requirements| Segment out-of-plane residual error

«TMT Requirement»

Applicable Subsystems = APS
Id = "16888"
Text = "
[REQ-1-OAD-0464] M1 segment phasing wavefront
measurement error 0.9970 5.8 WFSSP

"
TMT ID = "REQ-1-OAD-0464"



APS Performance Requirements: M1 tip/tilt/piston

See here for more info on the flow down of this requirement.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Segment tip/tilt/piston measurement error post AO

req [Package] APS Performance Requirements[Segment tip/tilt/piston measurement error post AO]

| | |
|---|--|
| «TMT Requirement» | «TMT Requirement» |
| Applicable Subsystems = APS Id = "16889" Text = "[REQ-1-OAD-0466] Low order wavefront measurement error Error allocation: 0.9992 Wavefront Error Allocation after AO (NFIRAOS) Correction (nm rms): 0.9" TMT ID = "REQ-1-OAD-0466" | Applicable Subsystems = APS Id = "16890" Text = "[REQ-1-OAD-0468] M1 segment tip/tilt wavefront measurement error Error allocation: 0.9908 Wavefront Error Allocation after AO (NFIRAOS) Correction (nm rms): 9.0" " TMT ID = "REQ-1-OAD-0468" |

 **APS Performance Requirements: M1 tip/tilt/piston**

See here for more info on the flow down of this requirement.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

TMT Requirement attributes

3.7 APS Product Assurance Requirements

APS Life Time

req [Package] APS Product Assurance Requirements[APS Life Time]

«TMT Requirement»

Id = "936"

Text = "[REQ-1-ORD-1000] The observatory shall be able to operate and meet all the requirements for 50 years with preventive maintenance. Preventive maintenance means servicing, repairing, and replacing components and subsystems based on their expected lifetime, as opposed to their failure."

TMT ID = "REQ-1-ORD-1000"

TMT ID = "REQ-1-ORD-1000"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

APS max. Down Time

req [Package] APS Product Assurance Requirements[APS max. Down Time]

«TMT Requirement»

Applicable Subsystems = APS
Id = "10922"
Text = "[REQ-1-OAD-0336] Alignment and Phasing System (APS) 0.17%"
TMT ID = "REQ-1-OAD-0336"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Diagnostics Telemetry

req [Package] APS Product Assurance Requirements[Diagnostics Telemetry]

«TMT Requirement»

Applicable Subsystems = AOESW, APS, LGSF, M1CS, M2, M3, MCS, STR, DMS, ESEN, TCS
Id = "1746"
Text = "[REQ-1-ORD-6210] The system shall extract information about the current condition of the system from the science and calibration data streams, and log this information along with other relevant system and environmental status information. Based on this information, it shall be possible to monitor, save, and analyze the technical performance of the system."
TMT ID = "REQ-1-ORD-6210"
TMT ID = "REQ-1-ORD-6210"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Electromagnetic Radiation

req [Package] APS Product Assurance Requirements[Electromagnetic Radiation]

«TMT Requirement»

Applicable Subsystems = ENC
Id = "1776"
Text = "[REQ-1-ORD-7410] The observatory shall not emit electromagnetic radiation at any frequency that significantly interferes with itself or the operation of any other current astronomical facility."
TMT ID = "REQ-1-ORD-7410"
TMT ID = "REQ-1-ORD-7410"

«problem»

We need specific standards to follow, or levels that we can measure to in order to verify this requirement.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

TMT Requirement attributes

Emergency Stop Switches shall interface with OSS

req [Package] APS Product Assurance Requirements[Emergency Stop Switches shall interface with OSS]

«TMT Requirement»

Applicable Subsystems = COAT, APS, ENC, IRIS, IRMS, LGSF, M2, M3, NFIRAOS, OSS, STR, SUM, WFOS
Id = "12743"
Text = "[REQ-1-OAD-7112] It is the responsibility of each subsystem to provide any emergency stop switches mounted at its location(s), and to connect them to the nearest interface to the OSS."
TMT ID = "REQ-1-OAD-7112"
TMT ID = "REQ-1-OAD-7112"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Environmental Regulations and Standards

req [Package] APS Product Assurance Requirements[Environmental Regulations and Standards]

«TMT Requirement»

Id = "1773"
Text = "[REQ-1-ORD-7400] The observatory shall comply with all local environmental regulation and international environmental standards applicable to the observatory site, appearance, and operations."
TMT ID = "REQ-1-ORD-7400"
TMT ID = "REQ-1-ORD-7400"

«problem» 

It would be nice if instead we were given a list of which these are... now every one has to go find them. These may be in the AD or RD list.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

TMT Requirement attributes

Fault Detection Notifications

req [Package] APS Product Assurance Requirements[Fault Detection Notifications]

«TMT Requirement»

Applicable Subsystems = CSW
Id = "16437"
Text = "[REQ-1-OAD-9312] CSW shall provide support for the use of the CSW services listed in 'Table: TMT Common Software services definitions' above by OESA components. Service support includes the following:
TMT ID = "REQ-1-OAD-9312"

«TMT Requirement»

Id = "16443"
Text = "

- For the purposes of fault detection, each OESA software subsystem or component shall have the ability to transmit an alarm using the Common Software Event Services when a situation occurs that prevents normal operations or abnormal condition occurs.

"

«problem»
This requirement should specify whom we send the alarm to.

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

TMT Requirement attributes

Minimize Hazardous Conditions

req [Package] APS Product Assurance Requirements[Minimize Hazardous Conditions]

«TMT Requirement»

Id = "1032"
System Engineering Notes = "This requirement does not need to be explicitly stated in the sub-system DRD. However it should be included as a discussion point within the safety or seismic sections of each DRD to ensure these operations are identified."
Text = "[REQ-1-ORD-1550] An earthquake up to and including the severity of the 200 year return period in some servicing modes may result in extensive damage to the observatory, or danger to personnel. Any operation that falls under this description shall be specifically identified in the appropriate system or sub-system Hazard Analysis, and the operational procedure shall be designed to minimize the time spent in this state."
TMT ID = "REQ-1-ORD-1550"
TMT ID = "REQ-1-ORD-1550"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Provide Emergency Stop Switches

req [Package] APS Product Assurance Requirements[Provide Emergency Stop Switches]

«TMT Requirement»

Applicable Subsystems = ENC, OSS, STR, SUM

Id = "917"

Text = "[REQ-1-OAD-7110] Emergency stop switches shall be conveniently and appropriately located throughout the summit facility as necessary to ensure adequate coverage and access in the event of an emergency."

TMT ID = "REQ-1-OAD-7110"

TMT ID = "REQ-1-OAD-7110"

TMT Requirement attributes

Author: fdekens

Version: 1.0

Modification Date: 9/5/23 5:03 PM

Completion Status: DRAFT

Reviewed by:

Last Modified by: rkarban

«problem»

We really should have an ICD that specifies an agreed upon location for these, since TMT should have concurrence on where these go.

Safety Priorities

req [Package] APS Product Assurance Requirements[Safety Priorities]

«TMT Requirements»

Id = "1762"
Text = "[REQ-1-ORD-7003] The safety priorities of the system shall be: (i) protection of persons, (ii) guarding the technical integrity of the observatory and other equipment potentially affected by the operation of the observatory, and (iii) protection of scientific data, in this order."
TMT ID = "REQ-1-ORD-7003"
TMT ID = "REQ-1-ORD-7003"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkaran | |

Self monitor operations

req [Package] APS Product Assurance Requirements[Self monitor operations]

«TMT Requirement»

Applicable Subsystems = COAT, APS, ENC, IRIS, IRMS, LGSF, M1CS, M2, M3, NFIRAOS, OSS, STR, SUM, CIS, WFOS

Id = "12712"

Text = "[REQ-1-OAD-6900] Each subsystem shall continuously monitor its own status and operation for the purpose of detecting faults or other hazardous conditions that can cause safety hazards and increase risk."

TMT ID = "REQ-1-OAD-6900"

TMT ID = "REQ-1-OAD-6900"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Self Monitoring

req [Package] APS Product Assurance Requirements[Self Monitoring]

«TMT Requirement»

Id = "1044"
Text = "[REQ-1-ORD-1720] The system shall monitor its own status to enable the assessment of whether a particular observation can be successfully completed."
TMT ID = "REQ-1-ORD-1720"
TMT ID = "REQ-1-ORD-1720"

«problem»

We should be told what to do under this condition, but maybe error handling is specified elsewhere and this is good enough.

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Send hazardous faults to OSS

req [Package] APS Product Assurance Requirements[Send hazardous faults to OSS]

«TMT Requirement»

Applicable Subsystems = COAT, APS, ENC, IRIS, IRMS, LGSF, M1CS, M2, M3, NFIRAOS, OSS, STR, SUM, WFOS
Id = "12715"
Text = "[REQ-1-OAD-6910] Upon detecting a hazardous fault or condition, a subsystem shall send an interlock request signal to the OSS."

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Take action to mitigate hazards

req [Package] APS Product Assurance Requirements[Take action to mitigate hazards]

«TMT Requirements»

Applicable Subsystems = COAT, APS, ENC, IRIS, IRMS, M1CS, M2, M3, NFIRAOS, OSS, STR, SUM, WFOS

Id = "12714"

Text = "[REQ-1-OAD-6905] Upon detecting a hazardous fault or condition, a subsystem shall independently and immediately take action to mitigate the hazard and reduce risk. The subsystem shall not require any interaction with, or the presence of, the OSS in order to do this."

TMT ID = "REQ-1-OAD-6905"

TMT ID = "REQ-1-OAD-6905"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

Withstand multiple E-Stops

req [Package] APS Product Assurance Requirements[Withstand multiple E-Stops]

«TMT Requirement»

Applicable Subsystems = APS, ENC, IRIS, IRMS, LGSF, M1CS, M2, M3, NFIRAOS, STR, SUM, CLN, CIS
Id = "918"
Text = "[REQ-1-OAD-7115] All subsystems and equipment interlocked by the OSS shall be capable of withstanding multiple emergency stop occurrences without damage."
TMT ID = "REQ-1-OAD-7115"
TMT ID = "REQ-1-OAD-7115"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

3.8 APS Programmatic Requirements

APS Maintainability and Standardization

req [Package] APS Programmatic Requirements§ APS Maintainability and Standardization]

«problem»

This should be split into separate requirements, such as metric units, maintainability requirements, etc. Discuss with TMT if they want to split this? (cleaner Metric requirement)



TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

APS Manuals, as build drawings, and parts lists

req [Package] APS Programmatic Requirements\$APS Manuals, as build drawings, and parts lists]

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

APS Responsibility

req [Package] APS Programmatic Requirements & APS Responsibility]

«TMT Requirement»

Applicable Subsystems = APS

Id = "826"

Text = "[REQ-1-OAD-0170] The Alignment and Phasing system decomposition element is defined as follows:

Associated WBS element(s): TMT.TEL.CONT.APS

The Alignment and Phasing System (APS) is responsible for the rigid body alignment of the M1, M2 and M3, as well as adjusting the surface figure degrees of freedom for the M1. As part of the alignment process APS will have the capability to phase the 492 M1 segments. APS will use starlight to measure the wavefront errors and then will determine the appropriate corrections to align the optics.

The APS will align the telescope at various elevation angles and then from the set points for the M1, M2 and M3 control systems, lookup tables will be generated to correct for gravity-induced deformations. In a similar fashion, data will be collected at various temperatures over time and lookup tables will be built as a function of temperature as well. APS is not responsible for the generation of the LUTs.

APS includes all the necessary hardware, software, and interfaces (to the TCS; and M1, M2, and M3 control systems) required to accomplish the alignment tasks defined above.

APS will have an acquisition camera with a 1 to 2 arcminute field of view which can be used for telescope pointing, acquisition, and tracking tests. APS will also provide an optical port where a guider camera and a low order wavefront sensor can be placed in order to test its performance and to validate the active optics control algorithms.

APS will provide an expert user GUI."

TMT ID = "REQ-1-OAD-0170"



| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

APS Spares

req [Package] APS Programmatic Requirements & APS Spares]

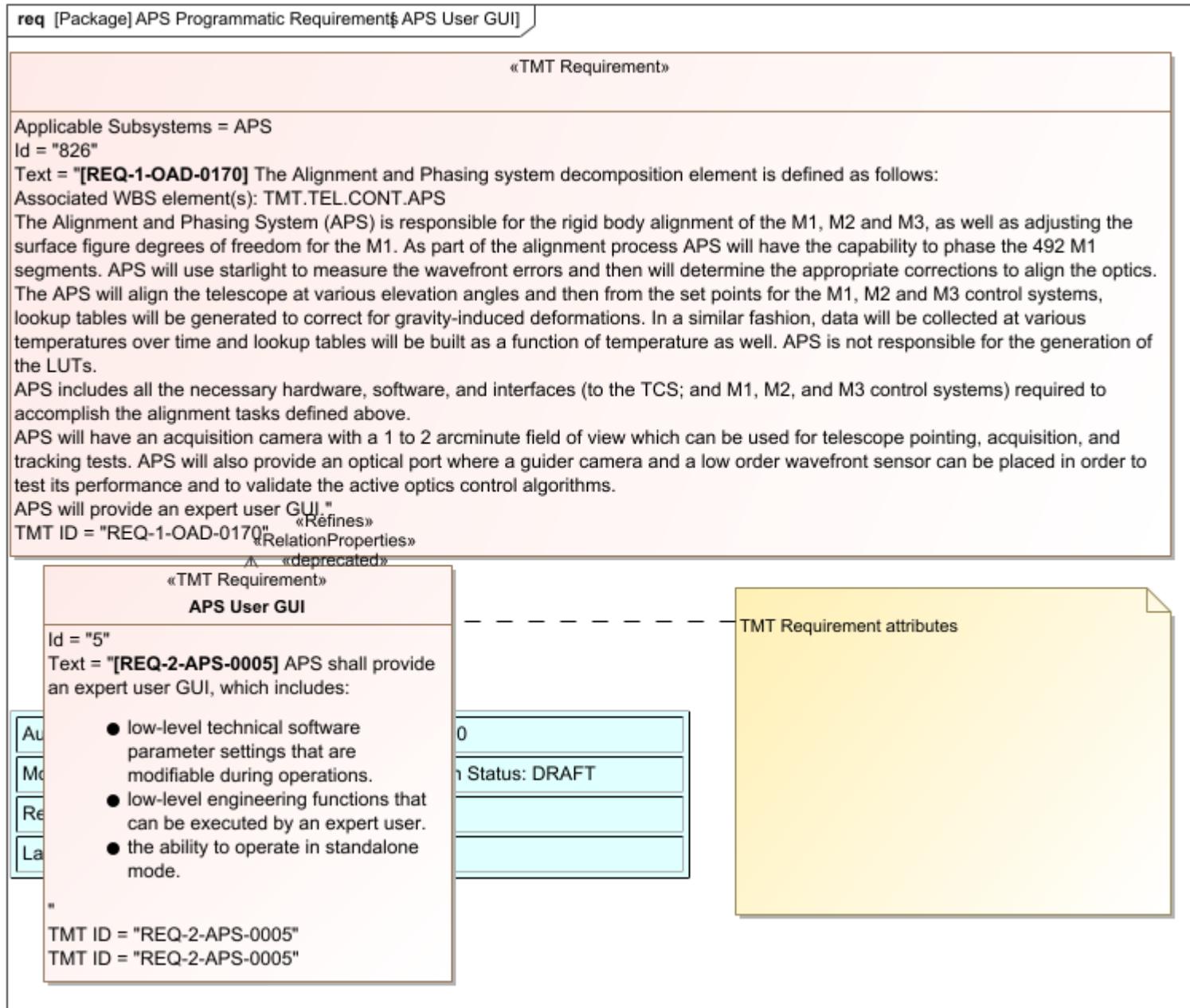
«problem»

This does not match our instructions
for sparing/costing Need better
definition that "where appropriate",
and in L2 specify what we'll spare.

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

APS User GUI



Comply with standards

req [Package] APS Programmatic Requirements & Comply with standards]

«TMT Requirement»

Id = "937"
Text = "[REQ-1-ORD-1005] The observatory shall comply with all local and national standards and regulations relevant to the construction and operation of the observatory. In justified cases, when (i) meeting the requirements of these standards would incur significant additional expenses, and (ii) deviation from the standard does jeopardize neither personal safety, nor the technical integrity of the system, the Project Manager may grant an exception to meeting a standard."
TMT ID = "REQ-1-ORD-1005"
TMT ID = "REQ-1-ORD-1005"

TMT Requirement attributes

| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

TMT Location

req [Package] APS Programmatic Requirements & TMT Location]

«TMT Requirement»

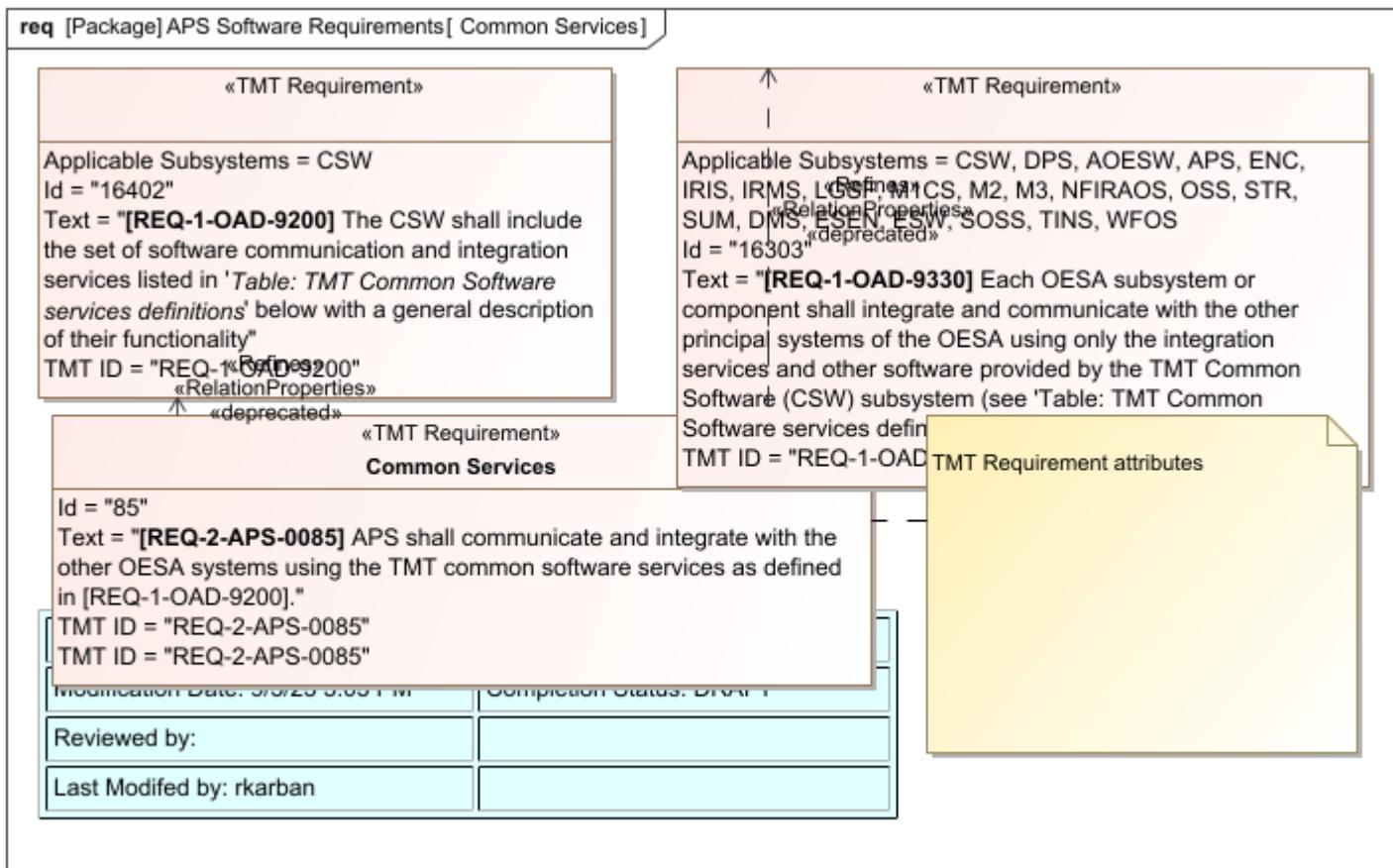
Id = "940"
Text = "[REQ-1-ORD-1050] The observatory shall be located at the 13N site on Mauna Kea, Hawaii, at latitude N 19°49'57.4", longitude W 155°28'53.4" at an altitude of 4012m."
TMT ID = "REQ-1-ORD-1050"
TMT ID = "REQ-1-ORD-1050"

TMT Requirement attributes

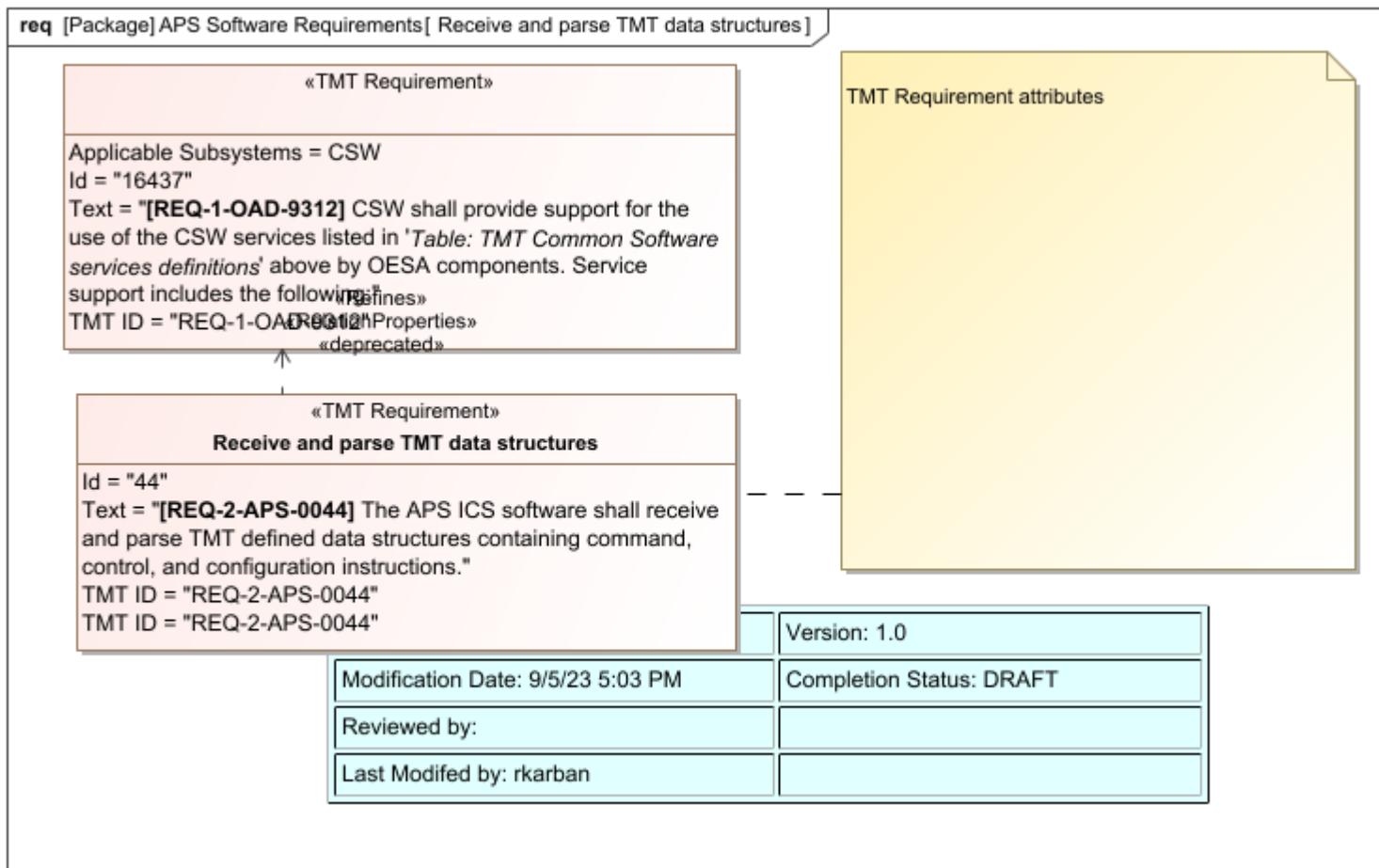
| | |
|-----------------------------------|--------------------------|
| Author: fdekens | Version: 1.0 |
| Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT |
| Reviewed by: | |
| Last Modified by: rkarban | |

3.9 APS Software Requirements

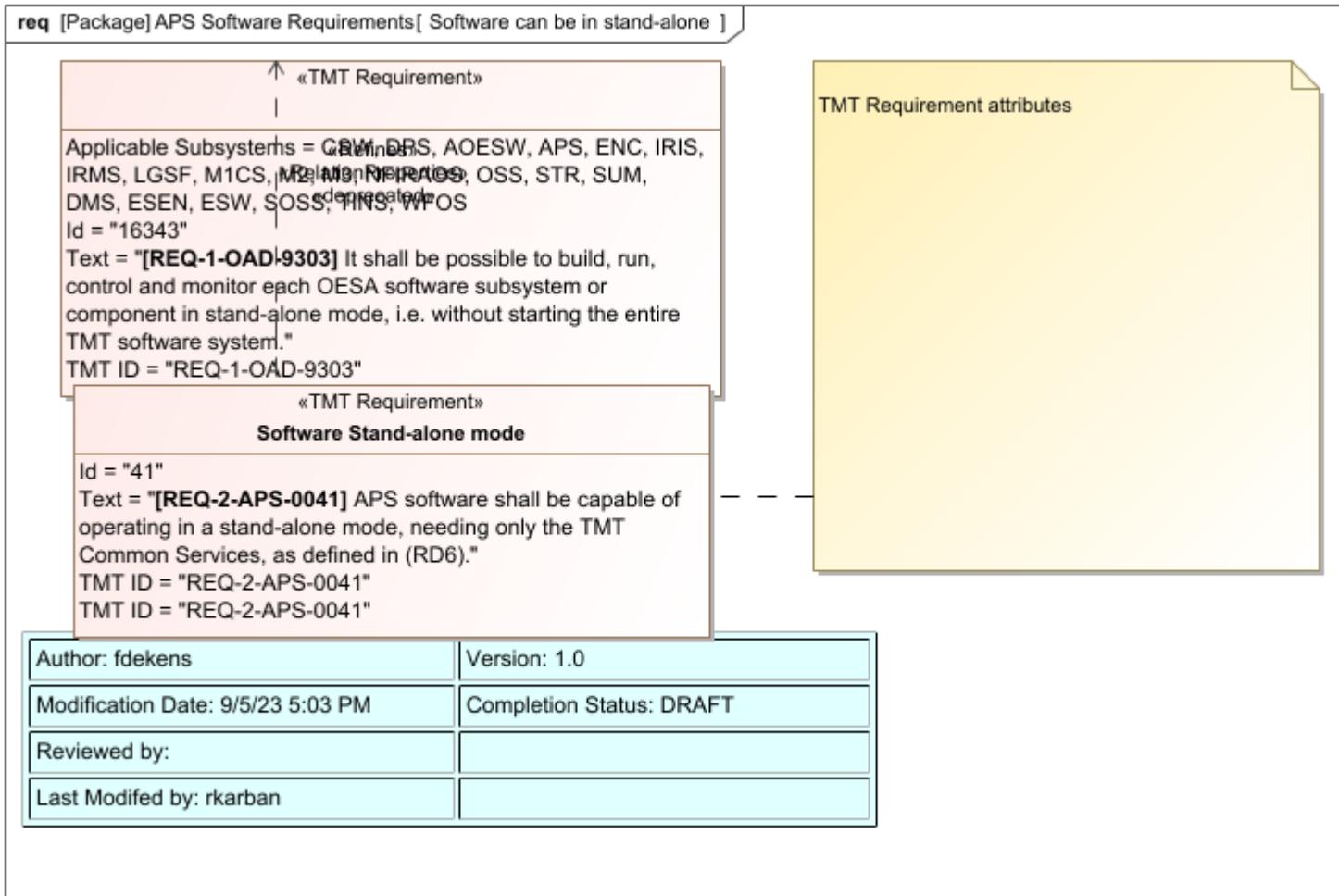
Common Services



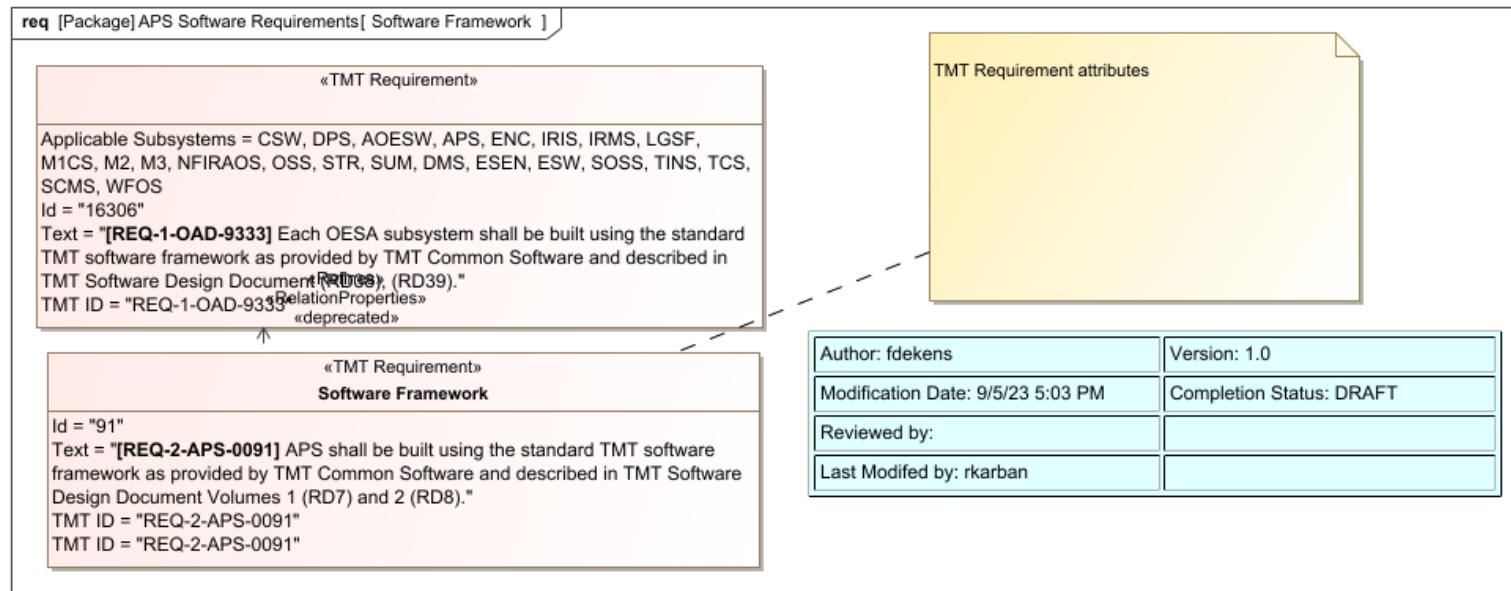
Receive and parse TMT data structures



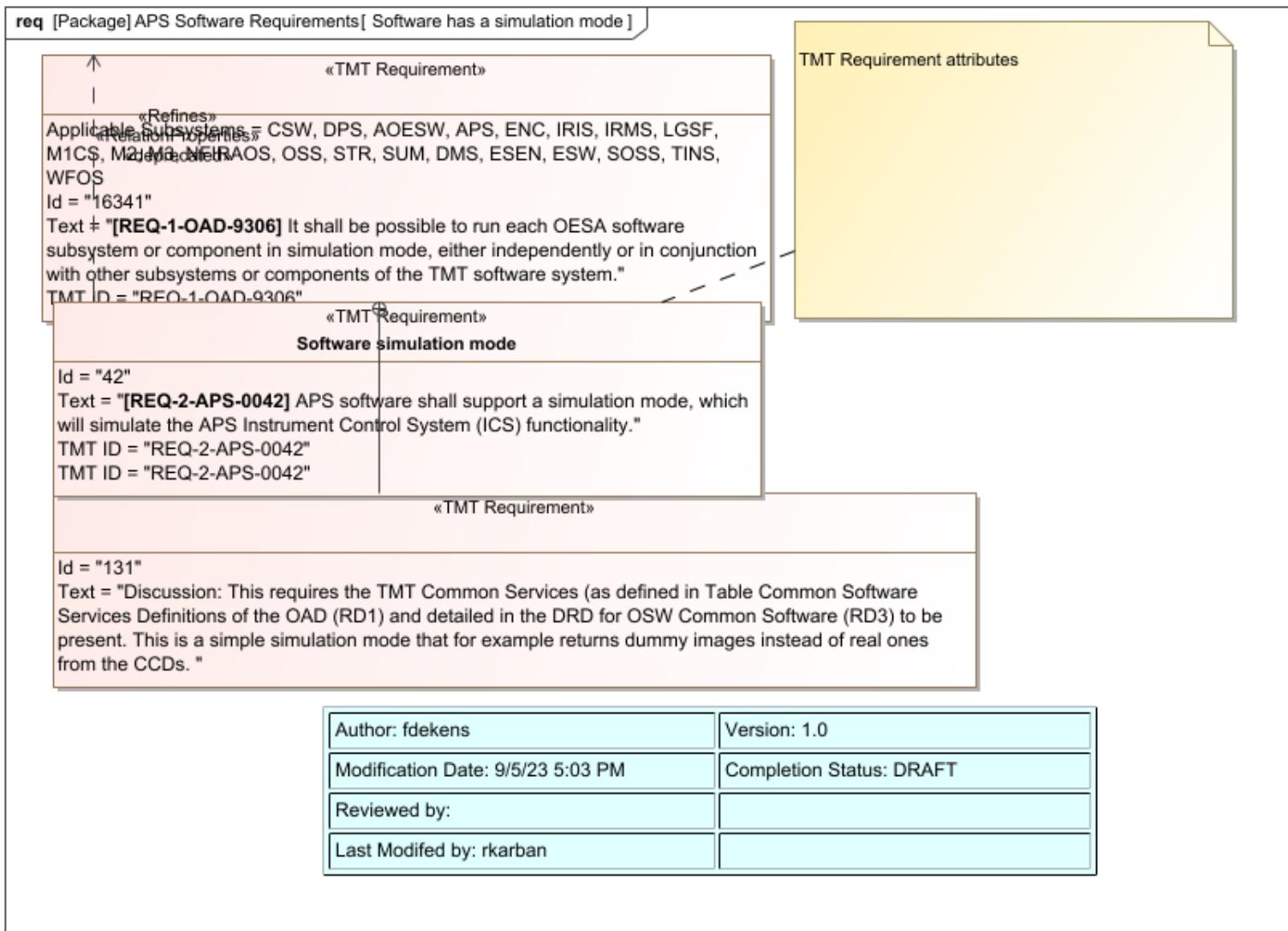
Software can be in stand-alone



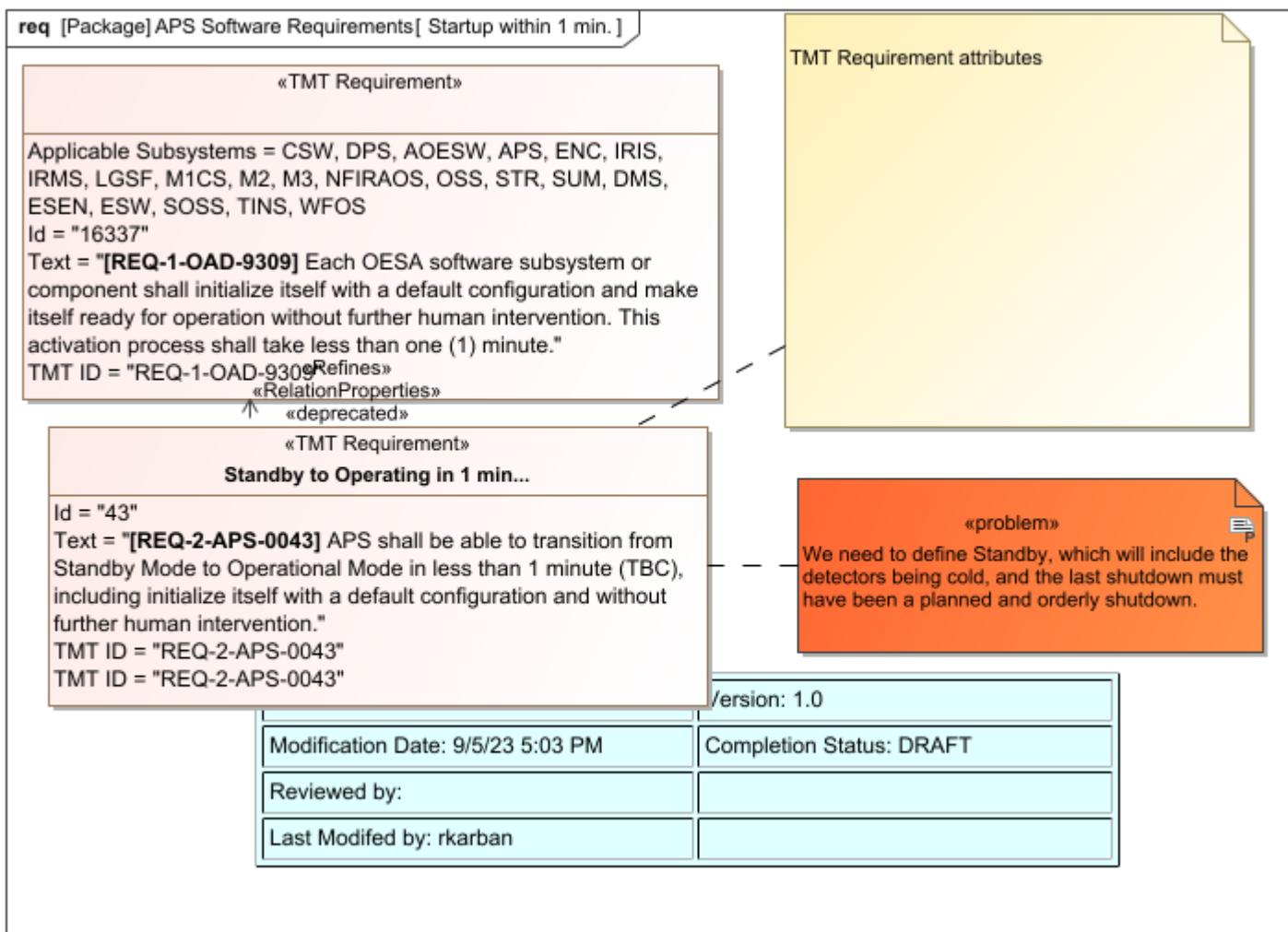
Software Framework



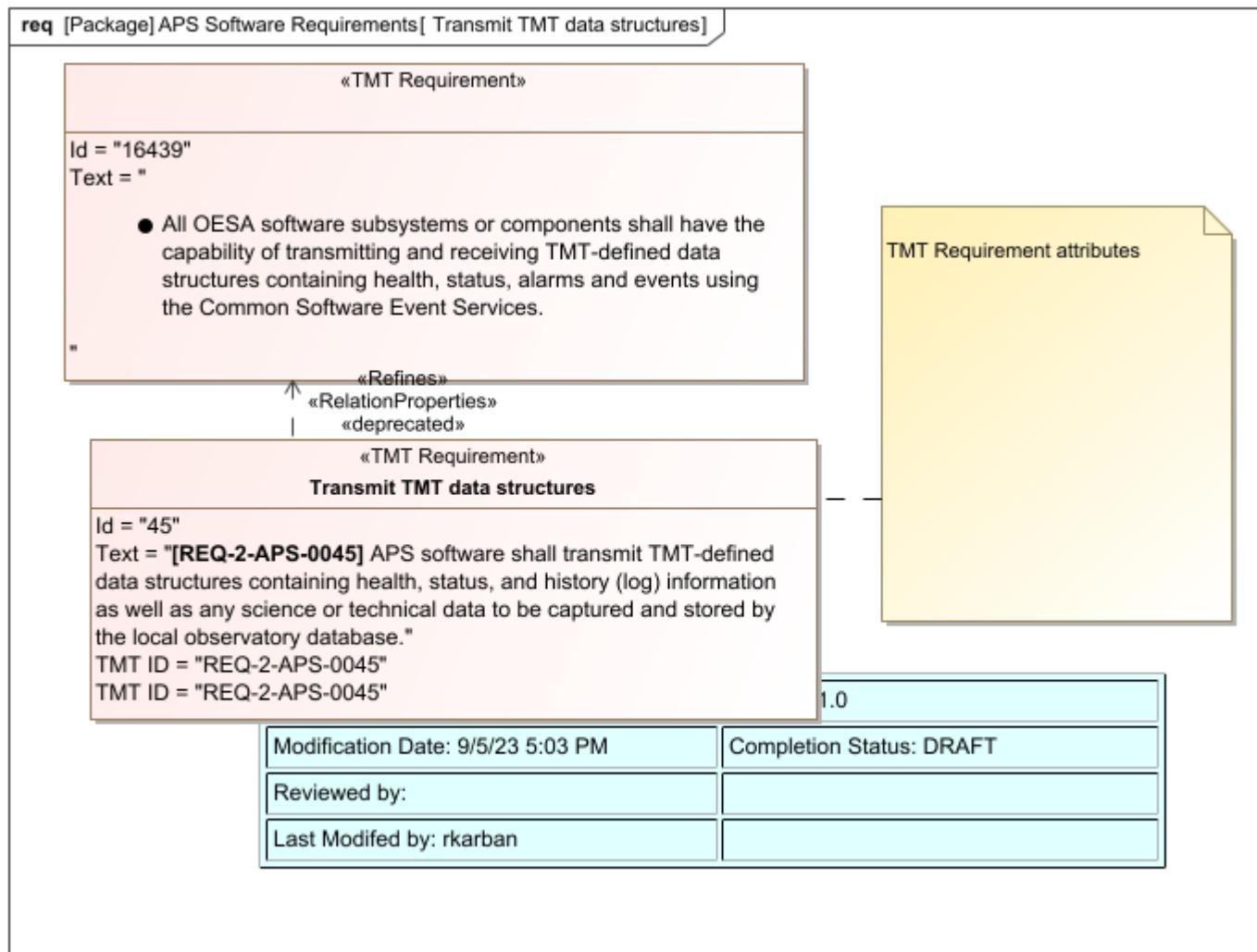
Software has a simulation mode



Startup within 1 min.



Transmit TMT data structures



3.10 APS Timing Requirements

Alignment Maintenance time

req [Package] APS Timing Requirements & Alignment Maintenance time

«TMT Requirement»

Applicable Subsystems = APS, M1, M1CS
Id = "6889"
Text = "[REQ-1-OAD-2325] The APS shall be able to perform on-axis alignment in less than 30 minutes (at a single elevation angle) when all optics are within the alignment maintenance specifications."
TMT ID = "REQ-1-OAD-2325"
TMT ID = "REQ-1-OAD-2325"
 «Refines»
 «Iteration Properties»
 «deprecated»

«TMT Requirement»

Alignment Maintenance time

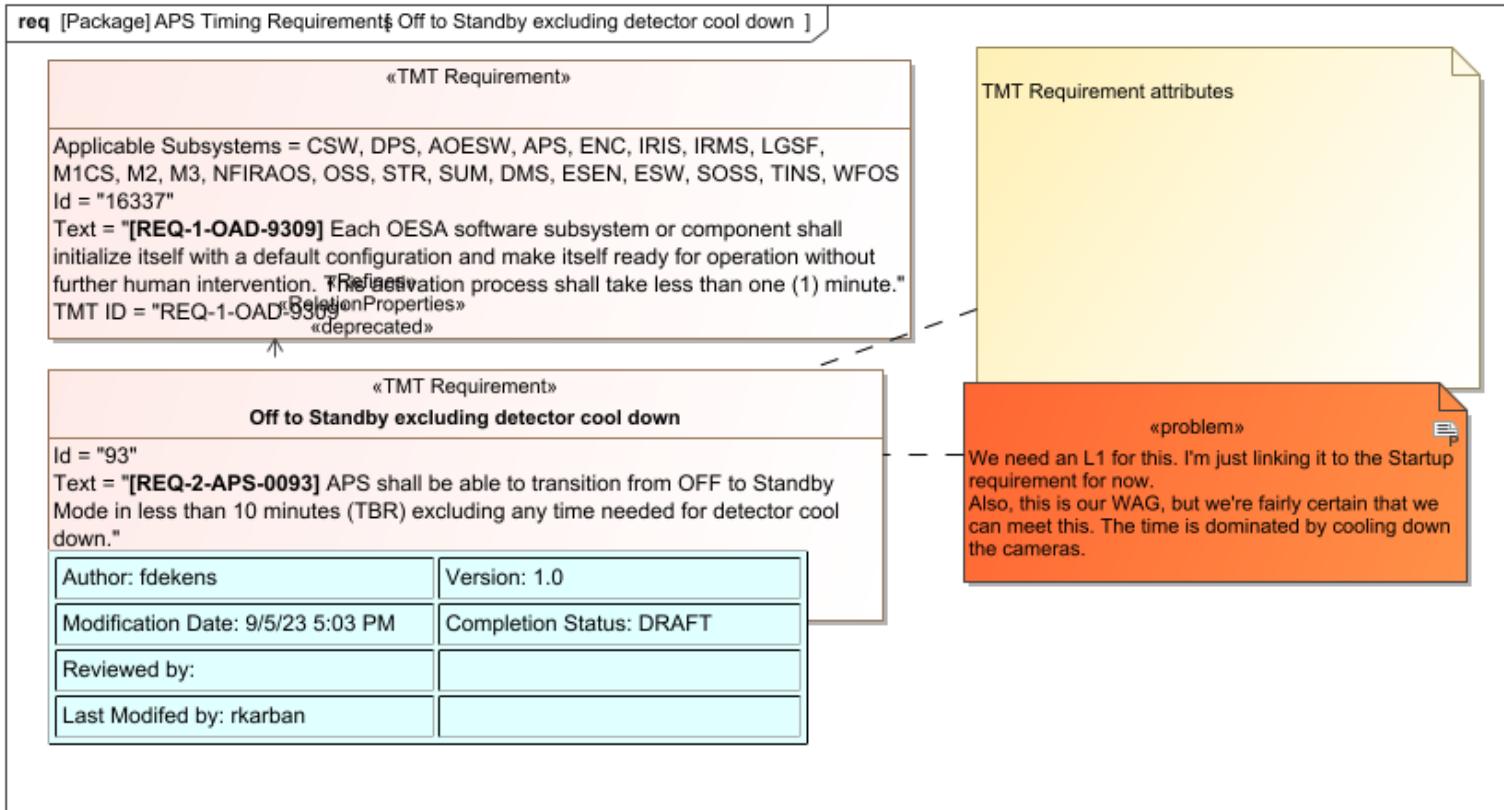
Id = "17"
Text = "[REQ-2-APS-0017] APS shall be able to perform on-axis alignment in less than 30 minutes (at a single elevation angle) when all optics are within the alignment maintenance specifications."
TMT ID = "REQ-2-APS-0017"
TMT ID = "REQ-2-APS-0017"

Modification Date: 9/5/23 5:03 PM | Completion Status: DRAFT

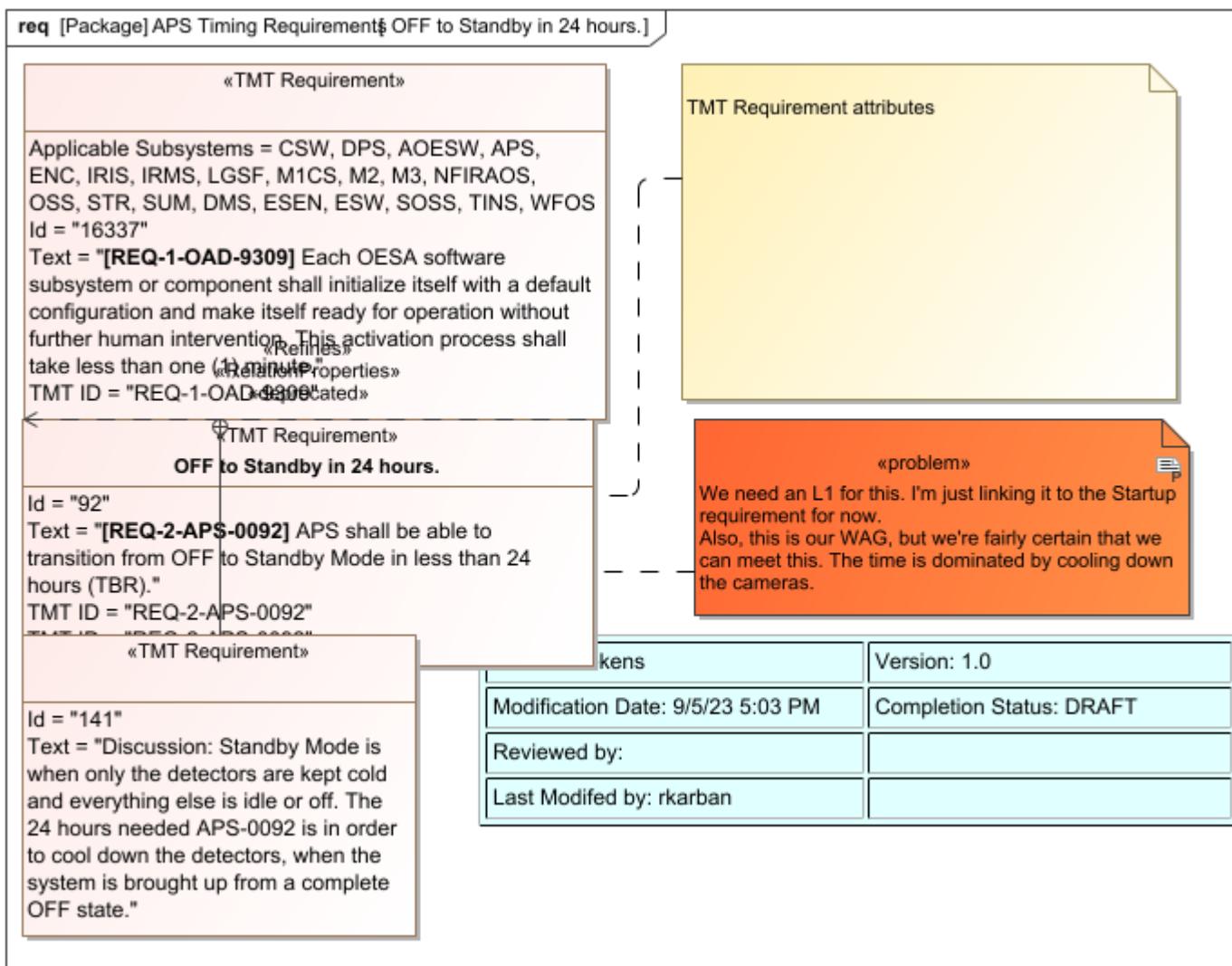
Reviewed by: 

Last Modified by: rkarban

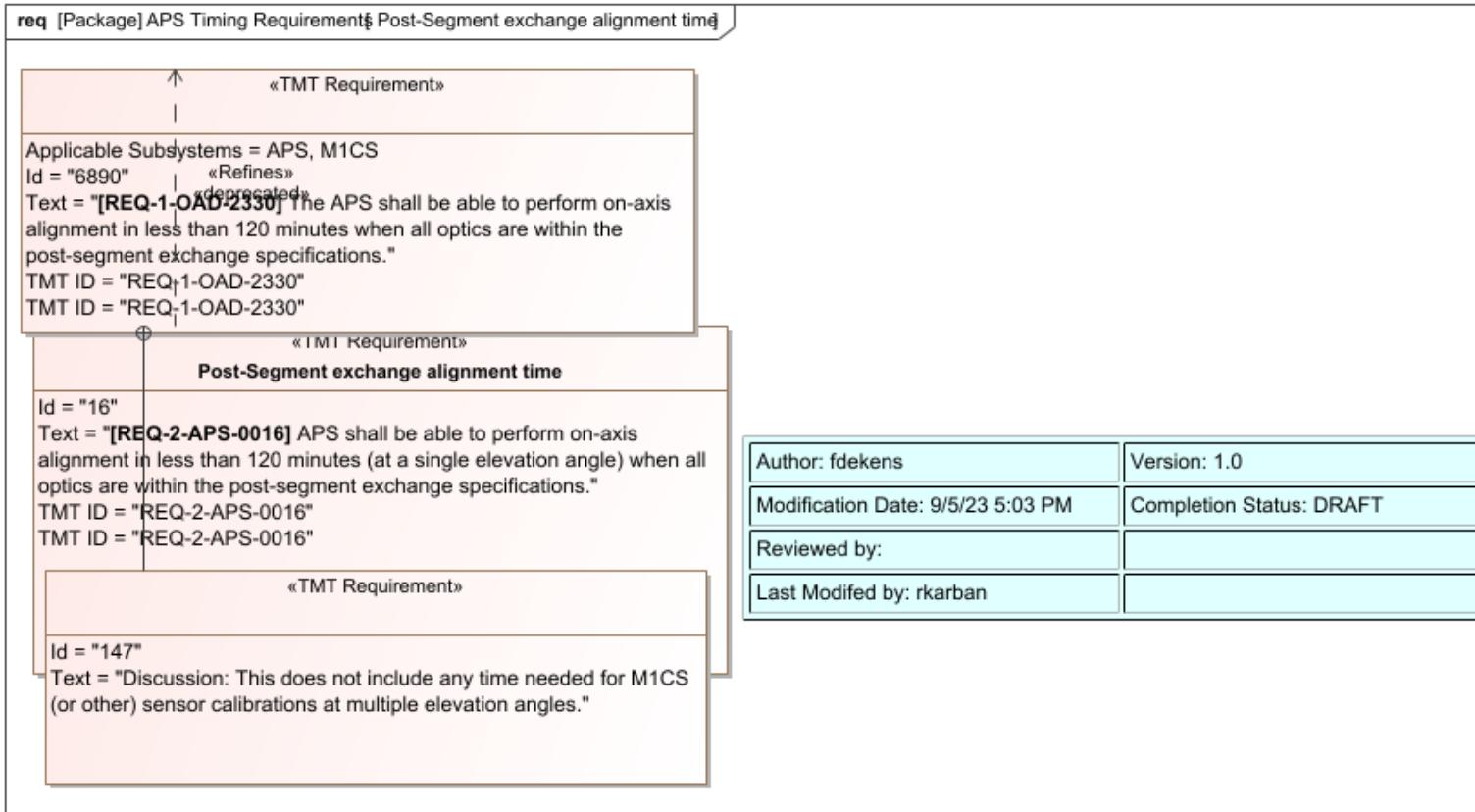
Off to Standby excluding detector cool down



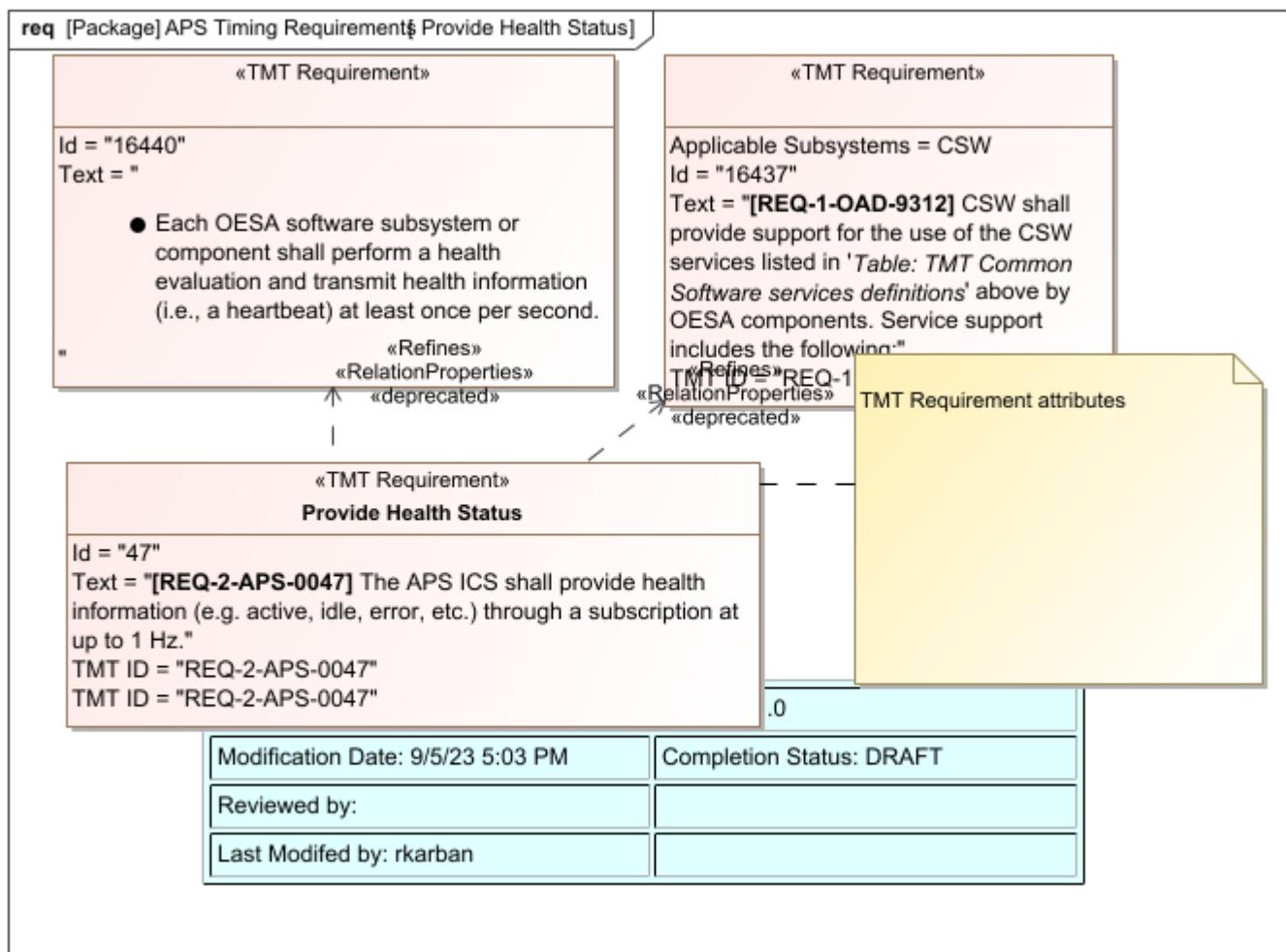
OFF to Standby in 24 hours.



Post-Segment exchange alignment time

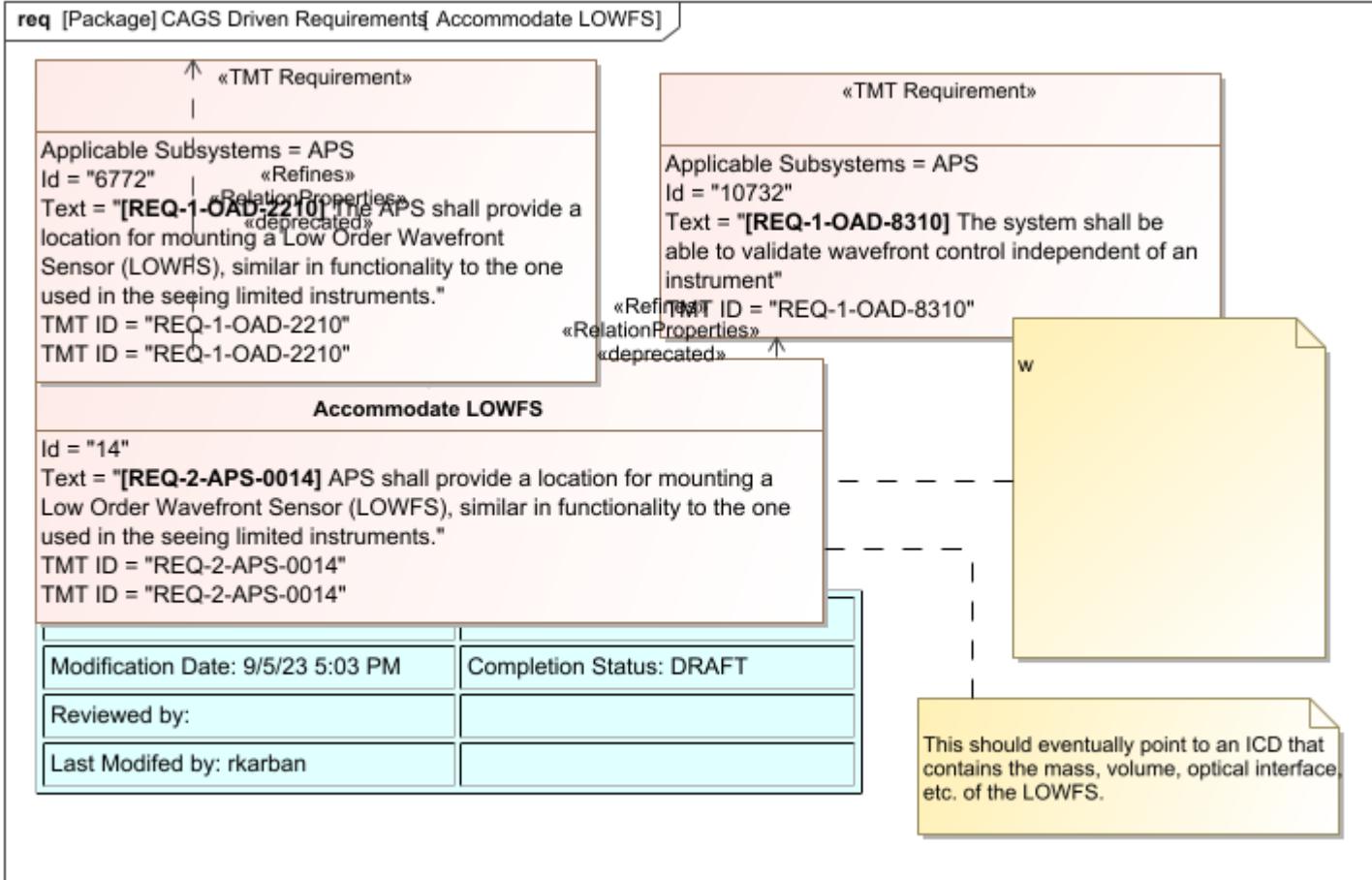


Provide Health Status

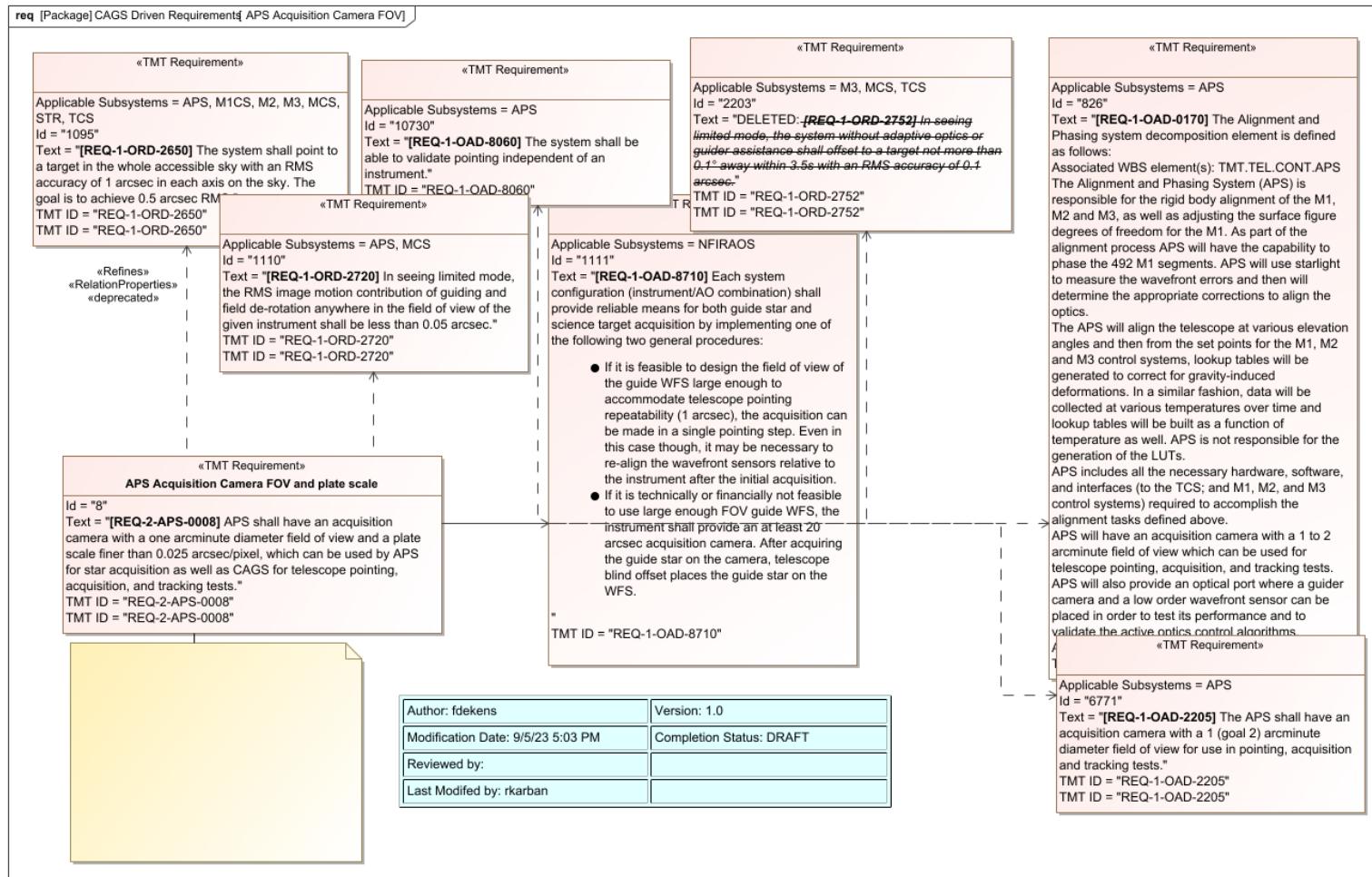


3.11 CAGS Driven Requirements

Accommodate LOWFS



APS Acquisition Camera FOV



3.12 ICD Requirements

4 Proposed changes to L1 TMT requirements

5 L1 TMT Parents Requirement Table

| # | ID | Name | SE Notes | APS Notes |
|---|----------------|--|----------|--|
| 1 | REQ-1-ORD-1375 | REQ-1-ORD-13 75 Component Functional Conditions | | Values are not in the parent requirement text, so if they change we will not know about it. They should either add the text in the requirement, or use a version number in the text, so we'll see a version increase if the table changes. |

6 L2 APS Requirement Table

| # | ID | Name | Requirement Text | Description | Refines |
|---|-----|--|---|---|---------|
| 1 | 102 | 102 APS Requirements | Txt | | |
| 2 | 113 | 113 Functional Requirements | Txt | | |
| 3 | 116 | 116 Operational Requirements | Txt | | |
| 4 | 73 | 73 Perform Maintenance while on Nasmyth platform | [REQ-2-APS-0073] The APS service and maintenance operations shall be possible while located on the Nasmyth Platform, from access positions defined in the STR-APS ICD (AD4). | 20160916 (ACM) ADMIN: Changed (AD8) to (AD4). | 1231 |
| 5 | 114 | 114 Environmental Requirements | Txt | | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|----------------|--|--|-------------|---------|
| 6 | REQ-2-APS-0070 | REQ-2-APS-0070 | The APS mechanical and electrical components shall function over the range of Component Functional Conditions , which are: <ul style="list-style-type: none">· Ambient air temperature range of -13 C to +25 C· Ambient air pressure range of 600 hPa to 1015 hPa (TBC)· Ambient air relative humidity of 0% to 100%, condensing conditions for components external to the enclosure, non-condensing internal to the enclosure | | |
| 7 | REQ-2-APS-115 | REQ-2-APS-115 Interface Requirements | <input type="button" value="Text"/> | | |
| 8 | REQ-2-APS-0004 | REQ-2-APS-0004 | APS shall comply with the interface documents specified in the [AD15] TMT Interface N^2 Diagram. | | |
| 9 | REQ-2-APS-0010 | REQ-2-APS-0010 APS at multiple Nasmyth locations | APS shall be able to operate at on and off axis Nasmyth mounting positions. | | 6506 |
| 10 | REQ-2-APS-0046 | REQ-2-APS-0046 | APS shall have a Contribution to the System Demand Load the Summit Facilities Building of less than 0.6 kW | | |
| 11 | 118 | 118 Performance Requirements | <input type="button" value="Text"/> | | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|---------------|----------------------------|---|-------------|---------|
| 12 | REQ-2-APS-144 | REQ-2-APS-14 4 | Discussion: As of 5/27/2014 the effective r0 used in the optical modeling is 3.6m which results in a PSSN of 0.990 and an AO corrected RMS segment WFE of ~10.2nm. This PSSN value is already worse than the linked OAD requirement (OAD-462) 0.995. This analysis needs to be rerun with the recently refined value for r0 of 3.2m and the L1 requirement updated. | | |
| 13 | 117 | 117 Optical Requirements | <input type="button" value="Txt"/> | | |
| 14 | 11 | 11 APS Entrance Pupil | [REQ-2-APS-0011] APS shall use the primary mirror as its pupil. | | 6427 |
| 15 | 19 | 19 Theoretical M1 geometry | [REQ-2-APS-0019] APS shall be designed to the TMT M1 theoretical perfect geometry as documented in the TMT M1 Segmentation Database (AD2). | | 12623 |
| 16 | 20 | 20 Telescope Pointing | [REQ-2-APS-0020] APS shall be designed to acquire objects given a telescope pointing accuracy of 3 (TBC) arcseconds RMS. | | 6273 |

| # | ID | Name | Requirement Text | Description | Refines |
|----|----|------------------------------|---|---|---------|
| 17 | 53 | 53 Pupil Obstruction | [REQ-2-APS-0053] APS shall accommodate the pupil obscuration pattern of the telescope as shown in Figure 3-1 (AD14). | This is pretty challenging for the central and spider obscured segment, so we need this diagram to be version controlled (probably not just a figure in the OAD since we don't know if it changes, unless they add a version number) 20160916 (ACM) Added new AD (AD14). | 6434 |
| 18 | 56 | 56 Focal Length | [REQ-2-APS-0056] APS shall accommodate a telescope final focal length of 450 m +/- TBD m. | The parent only gives the theoretical value, but we really need a range over which APS needs to work. This may not really be the important one. The F-ratio is probably more important, since that will be set by the primary/secondary as-build specifics. | 11130 |
| 19 | 57 | 57 Plate Scale | [REQ-2-APS-0057] APS shall accommodate a telescope focal plane image scale of 0.458366 +/- TBD arcsec/mm. | The parent only gives the theoretical value, but we really need a range over which APS needs to work. | 11130 |
| 20 | 86 | 86 Telescope Pupil Alignment | [REQ-2-APS-0086] APS shall measure the position the telescope pupil to an accuracy of 0.03 % the diameter of the pupil. | | 6781 |

| # | ID | Name | Requirement Text | Description | Refines |
|----|-----|---|--|--|---------|
| 21 | 87 | 87 Acquisition Camera | [REQ-2-APS-0087] APS shall have a n acquisition camera with a 1 arcmin diameter FOV (on the sky). | This needs to specify how BAD the telescope will point while NOT meeting it's pointing requirement. It still needs to be within reason, and may require implementing search patterns. | 1114 |
| 22 | 122 | 122 Timing Requirements | Txt | | |
| 23 | 16 | 16 Post-Segment exchange alignment time | [REQ-2-APS-0016] APS shall be able to perform on-axis alignment in less than 120 minutes (at a single elevation angle) when all optics are within the post-segment exchange specifications. | 1. Parent Requirement needs to state if it does not include M1CS sensor calibration and make this at a single elevation. 2. Another option is to write a parent requirement that includes both, delete the current APS-L1 requirement and flow down the 120 min. allocation to APS. | 6890 |
| 24 | 147 | 147 | Discussion: This does not include any time needed for M1 CS (or other) sensor calibrations at multiple elevation angles. | | |
| 25 | 17 | 17 Alignment Maintenance time | [REQ-2-APS-0017] APS shall be able to perform on-axis alignment in less than 30 minutes (at a single elevation angle) when all optics are within the alignment maintenance specifications. | | 6889 |

| # | ID | Name | Requirement Text | Description | Refines |
|----|-----|--|---|---|---------|
| 26 | 92 | 92 OFF to Standby in 24 hours. | [REQ-2-APS-0092] APS shall be able to transition from OFF to Standby Mode in less than 24 hours (TBR). | We need an L1 for this. I'm just linking it to the Startup requirement for now. Also, this is our WAG, but we're fairly certain that we can meet this. The time is dominated by cooling down the cameras. | 16337 |
| 27 | 141 | 141 | Discussion: Standby Mode is when only the detectors are kept cold and everything else is idle or off. The 24 hours needed APS-0092 is in order to cool down the detectors, when the system is brought up from a complete OFF state. | | |
| 28 | 93 | 93 Off to Standby excluding detector cool down | [REQ-2-APS-0093] APS shall be able to transition from OFF to Standby Mode in less than 10 minutes (TBR) excluding any time needed for detector cool down. | We need an L1 for this. I'm just linking it to the Startup requirement for now. Also, this is our WAG, but we're fairly certain that we can meet this. The time is dominated by cooling down the cameras. | 16337 |
| 29 | 43 | 43 Standby to Operating in 1 min... | [REQ-2-APS-0043] APS shall be able to transition from Standby Mode to Operational Mode in less than 1 minute (TBC), including initialize itself with a default configuration and without further human intervention. | We need to define Standby, which will include the detectors being cold, and the last shutdown must have been a planned and orderly shutdown. | 16337 |
| 30 | 121 | 121 Software Requirements | Txt | | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|-----|--|---|---|---------|
| 31 | 41 |  41 Software Stand-alone mode | [REQ-2-APS-0041] APS software shall be capable of operating in a stand-alone mode, needing only the TMT Common Services, as defined in (RD6). | defined in Table 40 of the OAD v27 - Referring to CCR27 Table 40 but CCR28 doesn't have Table numbering so changed the text to Table title and referenced OAD CCR28 (RD1) | 16343 |
| 32 | 42 |  42 Software simulation mode | [REQ-2-APS-0042] APS software shall support a simulation mode, which will simulate the APS Instrument Control System (ICS) functionality. | | 16341 |
| 33 | 131 |  131 | Discussion: This requires the TMT Common Services (as defined in Table Common Software Services Definitions of the OAD (RD1) and detailed in the RD for OSW Common Software (RD3) to be present. This is a simple simulation mode that for example returns dummy images instead of real ones from the CCDs. | defined in Table 40 of the OAD v27 - Referring to CCR27 Table 40 but CCR28 doesn't have Table numbering so changed the text to Table title and referenced OAD CCR28 (RD1) | |
| 34 | 44 |  44 Receive and parse TMT data structures | [REQ-2-APS-0044] The APS ICS software shall receive and parse TMT defined data structures containing command, control, and configuration instructions. | | 16437 |

| # | ID | Name | Requirement Text | Description | Refines |
|----|---------------|-------------------------------------|--|---|---------|
| 35 | 45 | 45 Transmit TM T data structures | [REQ-2-APS-0045] APS software shall transmit TMT-defined data structures containing health, status, and history (log) information as well as any science or technical data to be captured and stored by the local observatory database. | | 16439 |
| 36 | 91 | 91 Software Framework | [REQ-2-APS-0091] APS shall be built using the standard TMT software framework as provided by TMT Common Software and described in TMT Software Design Document Volumes 1 (RD7) and 2 (RD8). | | 16306 |
| 37 | 151 | 151 Software Development Process | [REQ-2-APS-0151] APS shall comply with TMT Software Development Process (AD1). | | 18566 |
| 38 | 85 | 85 Common Services | [REQ-2-APS-0085] APS shall communicate and integrate with the other OES A systems using the TMT common software services as defined in [REQ-1-O AD-9200]. | 05/2014: Need to revisit after L1 requirement updated. Note that the PDF has the table, but isn't referenced correctly, and the table isn't in DOORS. | |
| 39 | REQ-2-APS-161 | REQ-2-APS-161 Software Quality Plan | APS shall provide a Software Quality Plan as described in the Requirements for TMT Software Quality Assurance Plans document (A D6). | Txt | 18567 |

| # | ID | Name | Requirement Text | Description | Refines |
|----|---------------|---------------------------------|--|--|---------|
| 40 | REQ-2-APS-162 | REQ-2-APS-162 | Discussion: APS is currently planning to follow the TMT Software Development process. Doing so automatically satisfies the requirement to provide a software quality plan. | <input type="button" value="Txt"/> | |
| 41 | 5 | 5 APS User GUI | <p>[REQ-2-APS-0005] APS shall provide an expert user GUI, which includes:</p> <ul style="list-style-type: none"> ◦ low-level technical software parameters that are modifiable during operations. ◦ low-level engineering functions that can be executed by an expert user. ◦ the ability to operate in standalone mode. | | |
| 42 | 140 | 140 | Discussion: The GUI will be a web based interface, so it can be run anywhere. This will be handled by APS-PEAS. | | |
| 43 | 49 | 49 Communication through Events | <p>[REQ-2-APS-0049] APS shall be able to transmit and receive software events using the event service provided by common services.</p> | <ol style="list-style-type: none"> 1. The parent, and then the child should call out an Event spec of what we're really using to do this. 2. REQ-1-OAD-9312 should have the APS applicability flag set | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|-----|--|---|---|---------|
| 44 | 50 | 50 Instrument Control System to interface to TMT | <p>[REQ-2-APS-0050] APS shall have a n Instrument Contr ol System (ICS) tha t encompasses all t he necessary softw are subsystems (e .g. HCD, compone nt controller, detect or controller, etc.) n eeded to command and control the inst rument as well as i nterface it to the re st of the TMT softw are system.</p> | | 16297 |
| 45 | 61 | 61 APS Diagnostics Requirements | <p>[REQ-2-APS-0061] APS ICS shall pro duce status and dia gnostic telemetry fo r the purposes of p erformance monito ring and failure ana lysis.</p> | | |
| 46 | 47 | 47 Provide Heal th Status | <p>[REQ-2-APS-0047] The APS ICS shal l provide health info rmation (e.g. active , idle, error, etc.) th rough a subscriptio n at up to 1 Hz.</p> | | |
| 47 | 48 | 48 Maintain Acti vity Log | <p>[REQ-2-APS-0048] APS shall transmi t a time-stamped a ctivity log to the loc al observatory data base using commo n services.</p> | REQ-1-OAD-9312 should have the A PS applicability fla g set | |
| 48 | 128 | 128 CAGS Driv en Requirements | <input type="button" value="Txt"/> | | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|-----|--|--|--|---------|
| 49 | 129 | ■ 129 | Discussion: The requirements in this section provide the CAGS functionality , which enable TCS validation of telescope requirements, such as pointing, tracking and guiding. | | |
| 50 | 14 | ■ 14 Accommodate LOWFS | [REQ-2-APS-0014] APS shall provide a location for mounting a Low Order Wavefront Sensor (LOWFS), similar in functionality to the one used in the seeing limited instruments. | 1) This should point to an ICD that contains the mass, volume, optical interface, etc. | |
| 51 | 8 | ■ 8 APS Acquisition Camera FOV and plate scale | [REQ-2-APS-0008] APS shall have an acquisition camera with a one arcminute diameter field of view and a plate scale finer than 0.025 arcsec/pixel, which can be used by APS for star acquisition as well as CAGS for telescope pointing, acquisition, and tracking tests. | | |
| 52 | 124 | ■ 124 APS Acquisition Camera field distortion | [REQ-2-APS-0124] The APS Acquisition Camera shall have a plate scale distortion of less than 100 milli-arcsec over 10 arcsecs in the center of the field , and less than 2 arcseconds over the entire FOV. | | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|-----|--|--|---|---------|
| 53 | 125 | ■ 125 APS Acquisition Camera image quality | [REQ-2-APS-0125] The APS Acquisition Camera shall have an image quality of better than 0.5 arcsec over the entire FOV. | | |
| 54 | 126 | ■ 126 APS Acquisition Camera sensitivity | [REQ-2-APS-0126] The APS Acquisition Camera shall have a centroiding error of less than 25 milli-arcseconds, with a 20 sec exposure on a 14th mag star, and a 0.1 sec exposure on an 8th mag star. | | |
| 55 | 127 | ■ 127 APS Acquisition Camera update rates | [REQ-2-APS-0127] The APS Acquisition Camera shall support a full image update rate of faster than 0.2 Hz, and a 10 Hz update rate for regions of interest of up to 2 arcseconds. | | |
| 56 | 172 | ■ 172 Interface Requirements | Txt | Txt | |
| 57 | 173 | ■ 173 STR to APS ICD | [REQ-2-APS-0173] APS shall have a structural and mechanical interface with STR as described in section 3.2 of the STR to APS ICD (AD4). | 20160916 (ACM) ADMIN: Changed (AD8) to (AD4). | 12298 |
| 58 | 174 | ■ 174 APS to SER ICD | [REQ-2-APS-0174] APS shall have an electrical power interface with Computer Room as described in section 3.1 and 3.6 of the APS to SER ICD (AD16). | 20160916 (ACM) ADMIN: Changed (AD9) to (AD5). | 12298 |

| # | ID | Name | Requirement Text | Description | Refines |
|----|-----|---|---|---|---------|
| 59 | 175 |  175 SCMS to APS ICD | [REQ-2-APS-0175] APS shall adhere to the SCMS as shown in section TBD of interface control document (AD6). | 20160916 (ACM) A DMIN: Changed (A D10) to (AD6). | 12298 |
| 60 | 176 |  176 TCS to APS ICD | [REQ-2-APS-0176] APS shall adhere to the TCS as shown in section TBD of interface control document (AD7). | 20160916 (ACM) A DMIN: Changed (A D11) to (AD7). | 12298 |
| 61 | 177 |  177 APS to OSS ICD | [REQ-2-APS-0177] APS shall adhere to the OSS Software as shown in section TBD of interface control document (AD8). | 20160916 (ACM) A DMIN: Changed (A D12) to (AD8). | 12298 |
| 62 | 178 |  178 APS to SER ICD | [REQ-2-APS-0178] APS shall have an Communication data interface with CIS as described in section 3.1 and 3.6 of the APS to SER ICD (AD16). | 20160916 (ACM) A DMIN: Changed (A D13) to (AD9). | 12298 |
| 63 | 179 |  179 APS to CSW ICD | [REQ-2-APS-0179] APS shall adhere to the CSW as shown in section TBD of interface control document (AD10). | 20160916 (ACM) A DMIN: Changed (A D14) to (AD10). | 12298 |
| 64 | 180 |  180 APS to DMS ICD | [REQ-2-APS-0180] APS shall adhere to the DMS as shown in section TBD of interface control document (AD11). | 20160916 (ACM) A DMIN: Changed (A D15) to (AD11). | 12298 |
| 65 | 181 |  181 M1CS GLC to APS ICD | [REQ-2-APS-0181] APS shall adhere to the Alignment and Phasing System to Primary Mirror Control System Global Loop Controller Interface Control Document (AD12). | 20160916 (ACM) A DMIN: Changed (A D16) to (AD12). | 12298 |

| # | ID | Name | Requirement Text | Description | Refines |
|----|--------------|---|---|-------------|---------|
| 66 | 94 |  94 Introduction | <input type="button" value="Txt"/> | | |
| 67 | 95 |  95 Purpose | <input type="button" value="Txt"/> | | |
| 68 | 96 |  96 | This document contains the Alignment and Phasing System requirements. | | |
| 69 | 97 |  97 Scope | <input type="button" value="Txt"/> | | |
| 70 | 98 |  98 | This document provides a set of detailed functional, performance, interface, and environmental requirements for the design and implementation of the APS. | | |
| 71 | REQ-2-APS-99 |  REQ-2-APS-99 Acronyms | <input type="button" value="Txt"/> | | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|---------------|-------------------|---|-------------|---------|
| 72 | REQ-2-APS-217 | 7 REQ-2-APS-21 | APS Alignment and Phasing System CAGS Commissioning Acquisition and Guiding System CBE CCD Charge Coupled Device CSW Common Software DMS Data Management System DRD Design Requirements Document FOV Field of View GLC Global Loop Controller GUI Graphical User Interface HCD Hardware Control Daemon ICS Instrument Control System LOWFS Low Order Wavefront Sensor M1 Primary Mirror M1CS Primary Mirror Control System M2 Secondary Mirror M3 Tertiary Mirror MEL Master Equipment Value | Txt | |

NFPA National Fire Protection Association

OAD Observatory Architecture Document

OESA Observation Execution System Architecture

OSS Observatory Software

PEAS Procedure Executive and Analysis Software

PEL Program Execution Likelihood

RMS Root Mean Square

SCMS Site Conditions Monitoring System

STR Telescope Structure

SUM Summit Facilities

TBC To Be Confirmed

TBD To Be Determined

TBR To Be Reviewed

TCS Telescope Control System

TMT Thirty Meter Telescope

UPS Uninterruptible Power Supply

| | | | | WFE Wavefront Error | | |
|----|---------------|-------------------------|---|---------------------|---------|--|
| # | ID | Name | Requirement Text | Description | Refines | |
| 73 | 100 | 100 Reference Documents |  Text | | | |
| 74 | 107 | 107 | RD1 Observatory Architecture Document TMT.SEN.DRD.05.002 https://docushare.tmt.org/docushare/dsweb/Get/Document-2689 | | | |
| 75 | 108 | 108 | RD2 Optical Modeling Error Manual TMT.SEN.TEC.13.003 https://docushare.tmt.org/docushare/dsweb/Get/Document-23997 | | | |
| 76 | REQ-2-APS-109 | REQ-2-APS-109 | RD3 Observatory Architecture Document < http://project.tmt.org:8080/docushare/dsweb/Get/Document-2689 >, (TMT.SEN.DRD.05.002) | | | |
| 77 | 110 | 110 | RD3 Design Requirements Document for OSW Common Software TMT.SFT.DRD.08.002 https://docushare.tmt.org/docushare/dsweb/Get/Document-12130 | | | |
| 78 | REQ-2-APS-111 | REQ-2-APS-111 | RD5 - TMT Interface N ² Diagram < http://project.tmt.org:8080/docushare/dsweb/Get/Document-4780/TMT%20ICD%20N2%20v12.xls > (TMT.SEN.TEC.05.035) | | | |

| # | ID | Name | Requirement Text | Description | Refines |
|----|---------------|--------------------------------------|--|---|---------|
| 79 | REQ-2-APS-112 | REQ-2-APS-11 2 | RD6 - APS Requirements Flow-Down https://docushare.tmt.org/docushare/dswb/Services/Document-26638 (TMT.IAO.DRD.13.004.DRF01) | | |
| 80 | 101 | 101 Overview of the Document | [Txt] | | |
| 81 | REQ-2-APS-298 | REQ-2-APS-29 8 Change Record | [Txt] | [Txt] | |
| 82 | REQ-2-APS-300 | REQ-2-APS-30 0 | OLE_AB_5051efba363412fb_23_2100000201_280000012c_797b750e-40c1-4d6d-84dc-708fc0dd7666_OBJECTTEXT_0.rtf OLE Object | 20160916 (ACM) Updated Change History Record Table. | |
| 83 | REQ-2-APS-301 | REQ-2-APS-30 1 | OLE_AB_5051efba363412fb_23_2100000201_280000012d_797b750e-40c1-4d6d-84dc-708fc0dd7666_OBJECTTEXT_0.rtf OLE Object | [Txt] | |
| 84 | REQ-2-APS-305 | REQ-2-APS-30 5 | OLE_AB_5051efba363412fb_23_2100000201_2800000131_797b750e-40c1-4d6d-84dc-708fc0dd7666_OBJECTTEXT_0.rtf OLE Object | [Txt] | |
| 85 | 103 | 103 APS Architecture and Description | [Txt] | | |
| 86 | REQ-2-APS-104 | REQ-2-APS-10 4 APS Architecture | [Txt] | | |
| 87 | REQ-2-APS-105 | REQ-2-APS-10 5 APS Description | [Txt] | | |

| # | ID | Name | Requirement Text | Description | Refines |
|---|----|------|------------------|-------------|---------|
|---|----|------|------------------|-------------|---------|

| | | | | | |
|----|---------------|--|-------------------------------------|--|--|
| 88 | REQ-2-APS-106 |  REQ-2-APS-10 6 APS Relation to the System | <input type="button" value="Text"/> | | |
| 89 | REQ-2-APS-154 |  REQ-2-APS-15 4 Quality Control and Quality Assurance Requirements | <input type="button" value="Text"/> | | |
| 90 | 155 |  155 Appendix | <input type="button" value="Text"/> | | |
| 91 | 156 |  156 Proposed New Requirements | <input type="button" value="Text"/> | | |

7 L2 APS Requirements SE Working Notes

| # | ID | Name | SE Notes | APS Notes |
|----|----------------|--|---|--|
| 8 | REQ-2-APS-0004 |  REQ-2-APS-00 04 | | We now also have one requirement per ICD interface; so we should remove this and link the ICD ones to this parent. |
| 17 | 53 |  53 Pupil Obstruction | This is pretty challenging for the central and spider obscured segment, so we need this diagram to be version controlled (probably not just a figure in the OAD since we don't know if it changes, unless they add a version number) 20160916 (ACM) Added new AD (AD14). | This is pretty challenging for the central and spider obscured segment, so we need this diagram to be version controlled (probably not just a figure in the OAD since we don't know if it changes, unless they add a version number) |
| # | ID | Name | SE Notes | APS Notes |

| # | ID | Name | SE Notes | APS Notes |
|----|----|---|--|--|
| 18 | 56 | 56 Focal Length | The parent only gives the theoretical value, but we really need a range over which APS needs to work. This may not really be the important one. The F-ratio is probably more important, since that will be set by the primary/secondary as-build specifics. | The parent only gives the theoretical value, but we really need a range over which APS needs to work. This may not really be the important one. The F-ratio is probably more important, since that will be set by the primary/secondary as-build specifics. |
| 19 | 57 | 57 Plate Scale | The parent only gives the theoretical value, but we really need a range over which APS needs to work. | The parent only gives the theoretical value, but we really need a range over which APS needs to work. |
| 21 | 87 | 87 Acquisition Camera | This needs to specify how BAD the telescope will point while NOT meeting its pointing requirement. It still needs to be within reason, and may require implementing search patterns. | This needs to specify how BAD the telescope will point while NOT meeting its pointing requirement. It still needs to be within reason, and may require implementing search patterns. |
| 23 | 16 | 16 Post-Segment exchange alignment time | 1. Parent Requirement needs to state if it does not include M1CS sensor calibration and make this at a single elevation. 2. Another option is to write a parent requirement that includes both, delete the current APS-L1 requirement and flow down the 120 min. allocation to APS. | Formalized Requirement |

| # | ID | Name | SE Notes | APS Notes |
|----|----|--|---|---|
| 26 | 92 | ■ 92 OFF to Standby in 24 hours. | We need an L1 for this. I'm just linking it to the Startup requirement for now. Also, this is our WAG, but we're fairly certain that we can meet this. The time is dominated by cooling down the cameras. | These two need L1 requirements, or maybe some generic operational requirement. Maybe there are generic similar parents in L1 as to how long it can take for the full telescope to be up and running (OFF to aligned, etc.) We need an L1 for this. I'm just linking it to the Startup requirement for now. Also, this is our WAG, but we're fairly certain that we can meet this. The time is dominated by cooling down the cameras. |
| 28 | 93 | ■ 93 Off to Standby excluding detector cool down | We need an L1 for this. I'm just linking it to the Startup requirement for now. Also, this is our WAG, but we're fairly certain that we can meet this. The time is dominated by cooling down the cameras. | These two need L1 requirements, or maybe some generic operational requirement. Maybe there are generic similar parents in L1 as to how long it can take for the full telescope to be up and running (OFF to aligned, etc.) We need an L1 for this. I'm just linking it to the Startup requirement for now. Also, this is our WAG, but we're fairly certain that we can meet this. The time is dominated by cooling down the cameras. |

| | | | | |
|----|----|--|--|--|
| 29 | 43 |  43 Standby to Operating in 1 min... | We need to define Standby, which will include the detectors being cold, and the last shutdown must have been a planned and orderly shutdown. | We need to define Standby, which will include the detectors being cold, and the last shutdown must have been a planned and orderly shutdown. |
| 43 | 49 |  49 Communication through Events | <p>1. The parent, and then the child should call out an Event spec of what we're really using to do this.</p> <p>2. REQ-1-OAD-93 12 should have the APS applicability flag set</p> | The parent, and then the child should call out an Event spec of what we're really using to do this. |

8 L1 Requirements to be DELETED

| # | ID | Name | SE Notes | APS Notes |
|---|----------------|--|----------|--|
| 1 | REQ-1-ORD-1375 |  REQ-1-ORD-13 75 Component Functional Conditions | | Values are not in the parent requirement text, so if they change we will not know about it. They should either add the text in the requirement, or use a version number in the text, so we'll see a version increase if the table changes. |