Description of document:	National Aeronautics and Space Administration (NASA) Reliability Assessment for the Webb Telescope Mission/Flight 2021
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National Aeronautics and Space Administration

Headquarters
Washington, DC 20546-0001

August 5, 2022

Reply to attn. of: Office of Communications

Re: NASA FOIA Tracking Number **22-GSFC-F-00621**

This is our final response to your Freedom of Information Act (FOIA) request to the National Aeronautics and Space Administration (NASA), dated November 7, 2021, and received in this office on June 16, 2022. Your request was assigned the above-referenced tracking number. You specifically seek:

> *"A copy of the reliability assessment document for the Webb Telescope launch mission. A copy of the reliability assessment document for the Webb Telescope flight mission."*

In response to your request, we conducted a search of NASA's Office of James Webb Space Telescope project using the search terms provided in your request. That search identified two documents responsive to your request totaling 9 pages. We reviewed the responsive records under the FOIA to determine whether they may be disclosed to you. Based on that review, this office is providing the following:

__8__ page(s) are released in full (RIF);[1]
__1__ page(s) are released in part (RIP);

NASA redacted from the enclosed documents certain information pursuant to the following FOIA exemptions:

[1] All page counts are approximate numbers.

Exemption 6, 5 U.S.C. § 552(b)(6)

Exemption 6 allows withholding of "personnel and medical files and *similar files* the disclosure of which would constitute a clearly unwarranted invasion of personal privacy." 5 U.S.C. § 552(b)(6)(emphasis added). NASA invokes exemption 6 to protect a work cell phone number. Disclosing the employee's work cell phone number, which the employee maintains in his home and on his person, could subject him to the type of harassment exemption 6 was designed to prevent.

Fees

Provisions of the FOIA allow us to recover part of the cost of complying with your request. In this instance, because the cost is below the $50 minimum, there is no charge.

Appeal

You have the right to appeal my action regarding your request. Your appeal must be received within 90 days of the date of this response. Please send your appeal to:

Administrator
NASA Headquarters
Executive Secretariat
ATTN: FOIA Appeals
MS 9R17
300 E Street S.W.
Washington, DC 20546

Both the envelope and letter of appeal should be clearly marked, "Appeal under the Freedom of Information Act." You must also include a copy of your initial request, the adverse determination, and any other correspondence with the FOIA office. In order to expedite the appellate process and ensure full consideration of your appeal, your appeal should contain a brief statement of the reasons you believe this initial determination should be reversed. Additional information on submitting an appeal is set forth in the NASA FOIA regulations at 14 C.F.R. § 1206.700.

Assistance and Dispute Resolution Services

If you have any questions, please feel free to contact me at Alyssa.k.bias@nasa.gov or (202) 358-4664. For further assistance and to discuss any aspect of your request you may also contact:

Stephanie Fox
Chief FOIA Public Liaison
Freedom of Information Act Office
NASA Headquarters
300 E Street, S.W., 5P32
Washington D.C. 20546
Phone: 202-358-1553
Email: Stephanie.K.Fox@nasa.gov

Additionally, you may contact the Office of Government Information Services (OGIS) at the National Archives and Records Administration to inquire about the FOIA mediation services it offers. The contact information for OGIS is as follows: Office of Government Information Services, National Archives and Records Administration, 8601 Adelphi Road-OGIS, College Park, Maryland 20740-6001, e-mail at ogis@nara.gov; telephone at 202-741-5770; toll free at 1-877-684-6448; or facsimile at 202-741-5769.

Important: Please note that contacting any agency official including myself, NASA's Chief FOIA Public Liaison, and/or OGIS is not an alternative to filing an administrative appeal and does not stop the 90 day appeal clock.

Sincerely,

Alyssa Bias

Alyssa Bias
Government Information Specialist

Observatory Requirements Verification Report

JWST-OBRVR-046117

Spacecraft and Optical Telescope Reliability (OBS-1692 and MR-368)

Organization – Discipline: Observatory

GSFC Subject Matter Expert:
Name: Matthew Samuel
Title: Associate, Safety & Mission Assurance
Phone Number: 301 286 6475
Email: matthew.v.samuel@nasa.gov

RVR Written by:
Name: Gabe Lewis
Title: Mechanical Systems Engineer
Phone Number: (301) 286 9478
Cell Phone Number: (b) (6)
Email Address: gabriel.w.lewis@nasa.gov

Approved by:		Concurred by:	
Electronic approval	*07/21/2021*	*Electronic approval*	*06/30/2021*
Judy Brannen JWST Observatory Requirements Manager	Date	Michael Davis Mission Systems Engineer	Date

1. Scope

This RVR addresses the verification requirements OBS-1692 and MR-368.

OBS-1692 and MR-368 share identical requirement text, and OBS-1692 is the only child requirement of MR-368. The same verification evidence set forth in this RVR applies to both requirements.

The VCRM in the following Specs define the verification methods as follows:

- OBS-1692 is to be verified via Analysis by Observatory as defined in Observatory Specification (JWST-SPEC-002020) Rev. AK
- MR-368 is to be verified via Analysis by Observatory as defined in Mission Requirements Document (JWST-RQMT-000634) Rev. AT

This RVR presents the Observatory verification evidence for these requirements.

2. Requirements Verified and Verification Summary

A top level verification summary for each requirement verified in this RVR can be found in Table 1 below.

Table 1. Observatory & Mission Requirement Verification Summary

ID	Requirement Text	Parent	I	A	D	T	Responsibility	OBS Verification Compliance Summary	Waiver/ Dev
OBS-1692	**Spacecraft and Optical Telescope Element Reliability** The Spacecraft and OTE shall have a combined reliability goal of 0.880.	MR-368		A			Observatory	The combined SC and OTE reliability prediction is calculated by straight multiplication of the element-level SC and OTE reliabilities at 0.858 and found to **not** meet the reliability goal of 0.880. Observatory-level reliability analysis shows that the updated NEA reliability is the primary driver primary of the lower reliability rates. The analysis also shows that the post-deployment reliability prediction is much higher than the goal at 0.9212. The updated lower NEA reliability prediction has been reviewed and accepted by NG and NASA.	None
MR-368		MR-390		A			SET		

3. Child Requirement Verification

The following requirement is are children of OBS-1692. These have been reviewed/approved via the associated SCRVR and OTRVR. Links to the associated JWST RVRs are provided in Section 4.

Table 2. Child Requirement Verification Summary

ID	Requirement Text	Parent	I	A	D	T	RESP	Verification Compliance Statement	Waiver/ Dev	JWST RVR	JWST Approvers
OBS-1694	**Spacecraft Reliability** The Spacecraft shall have a reliability goal of 0.893 for 5.5 years after launch.	OBS-1692		A			SCE	Reliability Analysis shows that all Spacecraft configured items, with the exception of the SS, SMS, and SCE meet the allocations specified in Table 2 of the RAD. However, an alternative approach to analyzing was incorporated, showing that after the deployment phase, the SCE reliability is 0.9325. The non-compliances of SS, SCE, and SMS to the goal requirement have been reviewed and accepted by NG & NASA.	None	JWS-SCRVR-046173	Davis, Michael S. Hernandez, Stephanie Huber, Jean M. Kelly, Joseph Lewis, Gabriel W. McClurg, Taylore Paschal, Laura Sabzehjou, Parham Tran, Hung
OBS-1693	**OTE Reliability** The OTE shall have a reliability goal of 0.985 for 5.5 years after launch.	OBS-1692		A			OTE	**JWST-OTRVR-033556** The OTE reliability prediction of 0.986 is an integration of unit level reliability results with reliability models based on the redundancy configuration as shown in the OTE reliability block diagram. **Referenced RVR for OBS-1693/OTE-385: JWST-RVR-029457 Rev-C** The OTE design does not meet the reliability goal (OTE-385) of 0.985 over 5.5 years. The latest NEA reliability analysis documented in JWST.2021.300.0100 "JWST Observatory Reliability Analysis Update" shows that the NEAs do not meet their unit-level reliability requirements. This non-compliance was accepted per ADR-W251. The Observatory level reliability analysis was updated to incorporate the NEA reliability change. JWST.2021.300.0100 shows that the OTE capability is 0.981 compared to a goal of 0.985. This non-compliance was reviewed and accepted by NG & NASA. The reliability predictions for all other OTE components did not change from the original OTE reliability prediction analysis (ref: IOC_JWST OTE Reliability Analysis Update Report_rev A_101515.docx). The original analysis was performed at the unit level and took into account redundancy configuration, piece part failure rate data, and applicable operational conditions (e.g., duty cycle, one-shot operation, etc.) Reliability models were based	ADR-W251	JWST-OTRVR-033556	Aland, Timothy Brannen, Judith Connolly , Dennis Davis, Michael S. Dell, Lawrence Hayden, Bill Huber, Jean M. Jones, Lori L. Russo, Lisa A. Samuel, Mathew

ID	Requirement Text	Parent	I	A	D	T	RESP	Verification Compliance Statement	Waiver/ Dev	JWST RVR	JWST Approvers
								on a redundancy configuration shown in the OTE reliability block diagram (ref: OTE CDR _ Mission Assurance.pptx)			

4. Verification Evidence

Due to the nature of the OBS-1692 requirement, this verification examines only SCE and OTE reliability calculations. The Observatory-level verification is taken as the combination of the SCE and OTE reliability numbers (via straight multiplication, i.e. [SCE Reliability] x [OTE Reliability] = [SCE & OTE Reliability]). Given the wording of the requirement, only SCE and OTE are relevant to this verification, and ISIM, Cryocooler, the Ground Segment, etc. are not considered. This verification references Observatory reliability model results updated to include the latest reliability analysis of Non-Explosive Actuators (NEAs) (post-Sunshield-redesign).

The Observatory and element level requirements are worded to specify reliability *goals*, and are not intended to mandate those reliability numbers as minimums.

The JWST Observatory Reliability Analysis Update (JWST-TM-046044, Reference 3) gives the following SCE, OTE, and Observatory reliability analysis results where:

- R[5.5-yrs]_Alloc shows the reliability allocation,
- R[5.5-yrs]_was shows the previous reliability calculation (pre-update),
- R[5.5-yrs]_IS_B column shows the updated reliability calculation post-launch/prior to deployment,
- R[5.5-yrs]_IS_B column represents the updated reliability calculation post-launch/post-deployment.

Table 3. JWST Observatory reliability results

element/subsys	R[5.5-yrs]_Alloc	R[5.5-yrs]_was	R[5.5-yrs]_IS_B	R[5.5-yrs]_IS_A
OBSERVATORY	**0.880**	**0.9026**	**0.8580**	**0.9212**
OTE	**0.985**	**0.9849**	**0.9810**	**0.9879**
SCE	**0.893**	**0.9165**	**0.8746**	**0.9325**
ACS	0.974	0.9759	0.9759	0.9753
CDH	0.975	0.9777	0.9777	0.9771
COMM	0.995	0.9960	0.9960	0.9960
DCS	0.995	0.9971	0.9971	0.9970
EPS	0.985	0.9885	0.9877	0.9893
PS	0.990	0.9963	0.9963	0.9962
SMS	0.995	0.9965	0.9930	1.0000
SS	0.980	0.9857	0.9447	1.0000
TCS	0.999	0.9998	0.9998	0.9998

The analysis results show that for the Observatory reliability after launch (during the first month of the deployment phase), the reliability goal of 0.880 at 5.5 years is not met, with an estimated reliability of 0.858. Note that the reliability of a single NEA is 0.999527, and there are 178 NEAs that must deploy successfully, each a single point of failure. The Observatory (SCE and OTE) does meet the performance requirements as listed in the rightmost column of the table above (R[5.5-yrs]_IS_A). Assessed performance is as 0.9212 versus goals of 0.880. The updated NEA reliability prediction and

resulting non-compliance has been accepted by NG and NASA per waiver ADR-W251 (Reference 7).

See additionally JWST-MEMO-046283 (Reference 6) which discusses the origins of and rationale behind the reliability requirement/goal in greater detail.

4.1. Mission-Level Requirement MR-368 Verification

Requirement MR-368 mirrors the text of OBS-1692, and the verification evidence presented to verify the Observatory-level requirement is the same for the Mission-level requirement. MR-368 has no other child requirements.

4.2. Spacecraft (SCE) Verification

The Observatory Specification document (JWST-SPEC-002020) Rev AK allocates requirement OBS-1694 to SCE for verification via Analysis. JWST-SCRVR-046173 (Reference 1) shows that all Spacecraft items meet the reliability goal specified in the requirement with the exception of the Sunshield (SS), Structures and Mechanisms Subsystem (SMS), and Spacecraft Element (SCE). As also discussed in Section 4.0 of this OBRVR, an alternate analysis method was used to show that SCE reliability after the deployment phase significantly exceeded the goal of 0.893, at 0.9325. The non-compliances of the

4.3. Optical Telescope Element (OTE) Verification

The Observatory Specification document (JWST-SPEC-002020) Rev AK allocates requirement OBS-1693 to OTE for verification via Analysis. RVR JWST-OTRVR-033556 (Reference 2) references JWST-RVR-029457 Rev-C (Reference 4) for OBS-1693 and its child OTE-385 (which mirrors its text). That RVR shows that OTE design does not meet the reliability goal (OTE-385) of 0.985 over 5.5 years due to the updated NEA reliability based on analysis documented in JWST-TM-046044. This non-compliance was accepted per ADR-W251 (Reference 7).

The Observatory level reliability analysis was updated to incorporate the NEA reliability change, indicating that the OTE capability is 0.981 compared to a goal of 0.985. This non-compliance was reviewed and accepted by NG & NASA. The reliability predictions for all other OTE components did not change from the original OTE reliability prediction analysis. As discussed in Section 4.0, the post-deployment OTE reliability is significantly higher than the 0.985 goal at 0.9879.

References

- Reference 1:
  - NGIN Link: JWST-SCRVR-046173

- Reference 2: OTE RVR: OTE Top-Level Mission Assurance Verifications (OTE-10, -385, -390, -400, -410, -420, -430 and OBS-347, -1693, -342, -343, -344, -345, -346)

- NGIN Link: JWST-OTRVR-033556

- Reference 3: (NGAS) OTE Requirements Verification Report: OTE Reliability and Lifetime (Rev C)
  - NGIN Link: JWST-RVR-029457 Rev-C

- Reference 4: JWST Observatory Reliability Analysis Update
  - NGIN Link: JWST-TM-046044

- Reference 5: OTE Requirements Verification Report: OTE Reliability and Lifetime (Rev C)
  - NGIN Link: JWST-RVR-029457 Rev-C

- Reference 6: Memo: JWST Reliability Requirements
  - NGIN Link: JWST-MEMO-046283

- Reference 7: Request for Deviation/Waiver: NEA Redundancy (ADR-W251)
  - NGIN Link: JWST-DEVW-046314

5. Compliance Statement and Conclusion

The Observatory shows that, while the combined SCE and OTE reliability did not meet the reliability goal, post-deployment reliability is considerably higher than the goal. The lower reliability driven by the NEAs has been reviewed and accepted by NG and NASA. Furthermore, the requirement itself is to be understood as a goal rather than as a mandate. Therefore, OBS-1692 is verified.