

National Aeronautics and Space Administration



Ames Research Center
Moffett Field, California 94035

November 12, 2020

Ms. Julianne Polanco
State Historic Preservation Officer
Office of Historic Preservation
Department of Parks & Recreation
1725 23rd Street, Suite 100
Sacramento, CA 95816

Attn: Mr. Mark Beason

Subject: Section 106 Consultation for Vertical Motion Simulator Out-the-Window Cockpit Visual Infrastructure Project at Ames Research Center, Moffett Field, Santa Clara County, California

Dear Ms. Polanco:

The National Aeronautics and Space Administration (NASA) Ames Research Center (ARC) requests Section 106 consultation on the Vertical Motion Simulator (VMS) Out-the-Window (OTW) Cockpit Visual Infrastructure Project (project or undertaking). NASA ARC proposes to upgrade the VMS, which is located in Building N243 on the Ames Campus at ARC (see Figures 1 and 2 in Appendix A in attachment). Building N243 is the Flight and Guidance Simulation Laboratory, which is listed in the National Register of Historic Places (NRHP). NASA ARC has determined that this project constitutes an undertaking under Section 106 of the National Historic Preservation Act of 1966 (54 United States Code § 306108), as amended. In support of its responsibilities under Section 106, NASA ARC is providing the following analysis, which includes a description of the undertaking, the Area of Potential Effects (APE), identification efforts, a description of the affected historic properties, and an assessment of potential effects resulting from the undertaking, for your review and concurrence.

Description of the Undertaking

The project involves updating the VMS in Building N243. The VMS is an apparatus in which operators are seated in an interchangeable cab (ICAB) with visual projectors that simulate the cockpits of aircraft or spacecraft for pilot/astronaut training purposes.

Currently, the ICAB OTW cockpit visual infrastructure is obsolete and partially inoperable. The existing Image Generator (IG), which produces the simulated imagery for the VMS, is located in Room 242, approximately 500 feet away in the opposite end of the building from the VMS and the VMS Laboratory. The projection display systems used for visual scene presentation in the cockpits are outdated, with degraded image brightness and color fidelity that do not meet minimum standards for piloted flight simulation research. The OTW display systems currently employ a Wide-Angle-Collimated (WAC) optical projection package dating to the late 1970s with 4:3 aspect ratio cathode ray tube displays to simulate real world depth of field visual cueing. Outdated aspect ratio and display technology render the existing suite of WAC display systems incompatible with today's wide aspect ratio, high-definition display technologies. The existing video switch routing and distribution system also dates to the late 1970s, with analog Red, Sync on Green, Blue (RGsB) video formats, a degraded coaxial video cable plant, and distribution electronics that are nonoperational. Replacement or upgrade of these infrastructure components is required to maintain the ability to conduct piloted simulation research at VMS.

The project would relocate IG operations to Room 231, which is less than 100 feet from the VMS Laboratory to optimize infrastructure and improve performance. The video switching, projectors, and optics systems that distribute the imagery from the IG to the VMS would be upgraded to an all-digital infrastructure. The project would replace obsolete analog video switching components with modern digital and flexible video switchers and replace failed projectors and optics in all ICABs with modern projectors and optics. This would address issues with signal loss due to degraded, excessively long cable runs; outdated, degraded video switchers for which no replacement parts are available; and insufficient brightness levels and loss of color uniformity of obsolete and degraded projectors and optics. The purpose of the project is to restore reliability of the VMS with the installation of new equipment, increase operational efficiency by eliminating re-tuning each time an ICAB is set up or relocated, and enhance image fidelity with digital signals, resulting in a visual infrastructure compatible with modern and future video technologies.

The project would include:

- Replacement of projectors for existing WAC and OTW display systems;
- Consolidation and relocation of the existing analog video infrastructure to optimize performance and sustainability during migration to digital video infrastructure;
- Replacement of legacy analog video switch routing, distribution and post processing equipment with digital technology; and
- Replacement of the WAC and OTW visual display systems with state-of-the-art digital visual technologies to support current and evolving high-definition display capabilities.

See Appendix B in the attachment for exhibits related to the project.

Area of Potential Effects

The APE is defined to address both direct and indirect impacts on potential historic properties and encompasses areas that may be affected by both temporary and permanent construction activities. The project involves interior alterations that would not cause any type of ground

disturbance; therefore, archaeological resources are not a concern and were not studied further. Activities are not anticipated to create visible, auditory, or atmospheric changes in the settings of adjacent historic properties; therefore, the APE is limited to the footprint of Building N243 (see Figure 4 in Appendix A, attached).

Identification Efforts

NASA ARC retained AECOM to conduct a technical study for this project (see Technical Memorandum for the VMS OTW Cockpit Visual Infrastructure Project dated October 30, 2020, attached). The study was conducted by cultural resources professionals who meet the Secretary of the Interior's Professional Qualifications Standards (48 Federal Register 44738). The APE encompasses one historic property, Building N243, previously listed in the NRHP in 2017. No ground-disturbing activities are proposed; therefore, archaeological resources were not considered as part of this study. For more details on the study's methodology, please see the attached memorandum provided for your review.

Affected Historic Properties

The Flight and Guidance Simulation Laboratory was listed in the NRHP at the national level of significance for its contributions in the areas of science and engineering related to the Space Shuttle Program (SSP) as a resource associated with the training of astronauts. The property is eligible under Criterion A for its association with training pilots and testing component features of the SSP, and under Criterion C for the design and engineering of the VMS, which is the world's largest motion-based simulator and widely regarded as the best simulator during its time for its engineering design and role in Space Shuttle pilot training. The property meets Criteria Consideration G for properties that have achieved significance within the past 50 years because of its exceptional significance within the context of the SSP for its contribution to the advancement of the SSP and the development and operation of the Space Shuttle orbiter by providing research and essential astronaut training in an accurately simulated orbiter. The period of significance is 1967 to 2011.

The VMS is located within a seven-story 1969 addition to Building N243, which is a 108,670-square-foot Brutalist-style building at the southeast corner of King Road and Cooper Loop at ARC. The VMS has a 110-foot-tall chamber and 60 feet of vertical and 40 feet of lateral motion capability. The basis of the motion system is a vertical platform that spans the width of the tower and is mounted on two columns that extend from 75-foot underground shafts. The vertical platform is restrained on both ends and in the center by wheel assemblies that ride along guide rails mounted to the tower walls. A lateral carriage mounted on the vertical platform provides horizontal motion. The lateral carriage is supported and restrained by wheel assemblies that ride along two guide rails attached to the top, front, and rear edges of the vertical platform. A detachable railing encircles the base structure for safety. The railing has an opening to accommodate a boarding ramp.

The VMS uses ICABs to simulate the cockpits of aircraft and spacecraft, including helicopters, tilt-rotors, fighter jets, transport aircraft, supersonic transports, and the Space Shuttle orbiters. Five ICABs are currently used on the VMS. The ICABs are all constructed of lightweight welded aluminum. A single ICAB is mounted to the top of the VMS on a large, flat, aluminum base that serves as the floor of the ICAB. A fixed aluminum canopy is also mounted to the base,

serves as the rear wall of the ICAB, and includes personnel and equipment access doors. Removable canopies enclose the equipment within the ICAB and serve as a barrier to exterior light and sound.

Other associated features of the VMS include the host computers, interfaces, test operations and control, and cueing systems. The host computers solve the equations that represent the mathematical model of the aircraft, perform all the computations needed to command and control the other parts of the system, and allow the pilot to interact with the simulator in real time. Interfaces serve as communications paths between the host computers and other elements of the simulation system. Test operations and control are located within the VMS Laboratory, a work area for personnel who conduct and direct simulations that includes operating and control consoles and other testing and monitoring equipment. Cueing systems generate and present sensory stimuli to the pilot. All these associated features are housed within Building N243.

See Appendix C in the attachment for the full NRHP nomination for Building N243.

Effects Assessment

The project would directly alter the VMS, a significant characteristic of the Flight and Guidance Simulation Laboratory (Building N243) for which it qualifies for the NRHP under Criterion C. The project proposes to relocate the IG, replace analog equipment with digital equipment, and replace the video displays for VMS operations. These alterations would allow the property to continue to be used for its historic purpose, retain the historic character of the property, and maintain reference to historic significance of the property's change over time. The alterations would not introduce conjectural historic features, apply chemical or physical treatments, or affect significant archaeological resources, and the alterations would be differentiated from original features and be compatible with the property. However, the project activities would replace deteriorated equipment with modern equipment, and the changes would not be reversible for practical purposes.

The study included an assessment of changes to Building N243's integrity that would result from the project. Based on the findings of the study, changes to the VMS would minimally impact Building N243. The project would not substantially diminish the integrity of Building N243's location, design, setting, materials, workmanship, feeling, or association. The continued function of the VMS as a large amplitude simulator for pilot and astronaut training would align with the VMS's historical associations as a highly technical and scientific facility.

Finding of Effect

Based on the assessment conducted by a qualified architectural historian, NASA ARC has made a finding of No Adverse Effect for this undertaking, per 36 CFR 800.5(b).

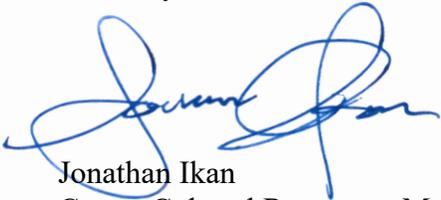
Consultation Efforts

Due to the limited scope of the project and its limited potential to cause effects on Building N243, NASA ARC has not identified additional consulting parties for this Section 106 review. However, NASA ARC is making these findings available to the public via the NASA ARC Historic Preservation Office website (<https://historicproperties.arc.nasa.gov/section106.html>).

NASA ARC requests the State Historic Preservation Officer's concurrence on NASA's determinations of eligibility pursuant to 36 CFR 800.4(c)(2) and finding of No Adverse Effect for this undertaking pursuant to 36 CFR 800.5(b). Please provide a response within 30 days of receipt of this letter, as specified in 36 CFR 800.5(c).

Please contact me at jonathan.d.ikan@nasa.gov or at (650) 604-6859 with your comments or questions.

Sincerely,



Jonathan Ikan
Center Cultural Resources Manager



Ames Research Center, MS 213-8
Moffett Field, California 94035

cc:

HQ/EMD/Dr. Rebecca Klein, Ph.D., RPA

Enclosures

Technical Memorandum for the VMS OTW Cockpit Visual Infrastructure Project, prepared by AECOM, dated October 30, 2020

