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Independent Nuclear Safety Assessment of the Non-Nuclear Verification Instrument NNV-470AS

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Abstract

The System Surety Assessment Department 12332 of Sandia National Laboratories performed an independent nuclear safety assessment of the Non-nuclear Verification Instrument NNV-470AS. The NNV-470AS was assessed for structural integrity, characteristics of its electrical circuits, and its Radiated Electrical Emissions. Department 12332 concluded that the NNV-470AS and its Operational Procedures are safe to use with war reserve weapons. However, strict adherence to the Operational Procedures for the NNV-470AS is needed to prevent tampering with the instrument.

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Introduction

The System Surety Assessment Department, 12332, at Sandia National Labs was requested to perform an independent nuclear safety assessment of the Non-Nuclear Verification Instrument, NNV-470AS, by The Stockpile Evaluation Department 1, 12361.

The purpose of the NNV-470AS is to verify that a test unit is indeed a Nuclear Explosive Like Assembly (NELA) and not a War Reserve (WR) weapon. This assessment covers the use of this instrument, NNV-470AS, for non-nuclear verification of test units for the following weapon programs only: B61, B83, W62, W76, W78, W80, W87, and W88. The NNV-470AS and this assessment are not valid for verifying the B53 NELAs as non-nuclear.

Scope of Assessment

It was assumed in this assessment, that the NNV-470AS Neutron Measurement Instrument would be used to make measurements on WR weapons.

The assessment covered the following:

- Structural integrity of the instrument
- Analysis of the electrical circuits
- Radiated Electrical Emissions
- Operating Instructions
- Operational Procedures/Unauthorized Tampering

The criteria for assessing the NNV-470AS instrument were:

- The energy generated by the instrument must not be capable of firing the weapon detonators.
- The energy generated by the instrument must be isolated within the instrument.
- The Operating Instructions must not cause a degradation in Nuclear Safety.
- The Operational Procedures must prevent spoofing the instrument and preclude the Insider Threat.

Summary

Based on the independent assessment analysis, it can be concluded that the NNV-470AS is safe to use with WR weapons. The significant findings of this analysis are:

- The instrument cannot generate sufficient current or voltage to fire the weapon detonators.
- Strict compliance with the established procedures is paramount to ensure that the instrument has not been tampered with during the time the unit is not under two-person control.

Assessment Analysis

Structural Integrity of the Instrument

The NNV-470AS instrument case and cover plate are constructed of a high-impact plastic with recessed attachment points for securing the cover plate to the case. The instrument is also equipped with an aluminum handle.

The plastic case provides electrical isolation for the instrument's internal electrical components. The only way for electrical energy to be coupled from inside the instrument to the outside would be an internal electrical short in the instrument that was coupled to the attachment screws for the handle or the access plate for the batteries. A breach in the plastic case would also allow coupling of internal electrical energy to the outside.

Inspecting the instrument as directed in the operating procedures precludes the use of the instrument if the case is found to be cracked or breached in any way.

Analysis of the Electrical Circuits

The internal energy sources for the NNV-470AS consist of two "C" sized alkaline batteries that provide 40 hours of power. The maximum voltage output from the instrument in a worst-case scenario is 1,000 volts with milliamps of current and would be generated by the HHV-454 high-voltage power supply. In a worst-case scenario, if this voltage and current were applied directly to the weapon detonators there would be insufficient energy to cause the detonators to fire. However, this does constitute sufficient energy to fire some of the older type electrical actuators used on various components of the B61, W62, W78, and W80. If the electrical actuators in one of these systems were to fire they would not generate a nuclear weapon detonation safety hazard.

Radiated Electrical Emissions

Radiated Emissions given off by the NNV-470AS while in operation have been tested in detail and show the instrument meets or exceeds all emissions requirements for both the Air Force and the Navy. Based on these tests the instrument does not represent a degradation in nuclear weapon safety from the standpoint of radiated emissions.

Operating Instructions

The operating instructions for the NNV-470AS have been reviewed in detail from the standpoint of nuclear weapon safety. The instructions, as written, do not prescribe any actions that would degrade nuclear weapon safety.

The positioning of the NNV-470AS on a weapon system is described in the appendix of the operating instructions. However, neither the instructions nor the accompanying figures clearly state that the NNV-470AS may not come in contact with the weapon system's external surface. From a nuclear weapon safety perspective, contacting the external surface of the weapon system with the NNV-470AS instrument does not represent a degradation in nuclear weapon safety.

Operational Procedures/Unauthorized Tampering

The five operational steps in the operational procedures were reviewed and found to be clearly stated and straight-forward. From a Use Control aspect these procedures, if not followed, could represent a vulnerability to the Non-Nuclear Verification program. Analysis of the NNV-470AS shows that it could be deliberately tampered with through the battery container so that it would give a null reading when neutrons were present. The only way to prevent this vulnerability is strict adherence to the written procedures.

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