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Nuclear Energy Experiments to the Center for Global Security and Cooperation

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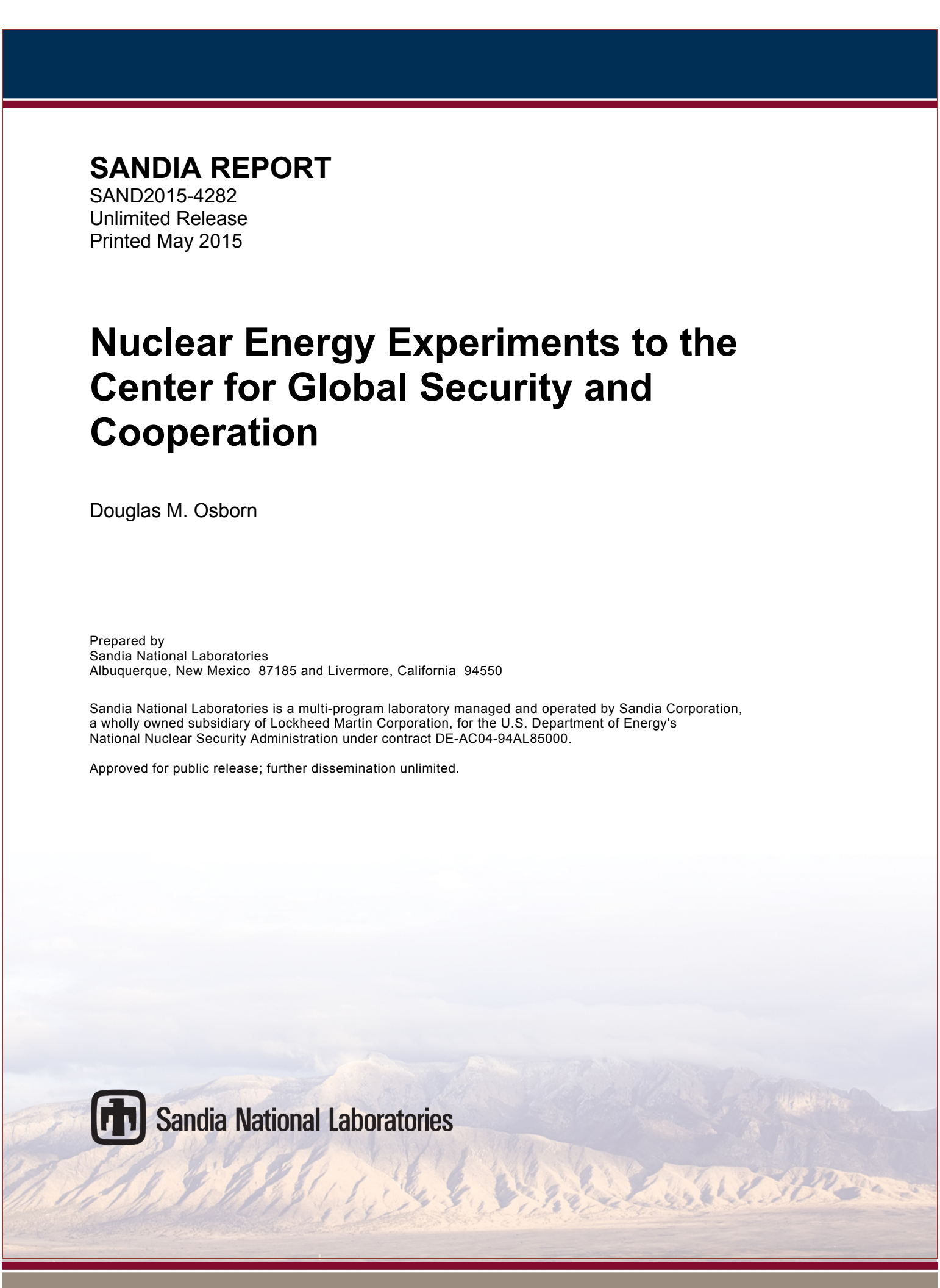

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Abstract

This is to serve as verification that the Center 6200 experimental pieces supplied to the Technology Training and Demonstration Area within the Center of Global Security and Cooperation are indeed unclassified unlimited released for viewing.

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NOMENCLATURE

CGSC	Center for Global Security and Cooperation
DOE	Department of Energy
NEA	Nuclear Energy Agency
NRC	U.S. Nuclear Regulatory Commission
OECD	Organization for Economic Cooperation
RPV	Reactor Pressure Vessel
SNL	Sandia National Laboratories
TMI-2	Three Mile Island Unit 2
TTD	Technology Training and Demonstration Area

1. INTRODUCTION

As part of the Center 6200 addition to the Technology Training and Demonstration Area (TTD) within the Center of Global Security and Cooperation (CGSC), two nuclear energy experimental pieces are to be added. These two experimental pieces, a reactor vessel lower head and a ¼-scale spent nuclear fuel transportation cask, are to be moved from TA-III to the TTD. However, prior to acceptance of the CGSC Building Manager, an official confirmation is need that the experimental pieces are indeed unclassified unlimited release for viewing by all.

2. REACTOR VESSEL LOWER HEAD EXPERIMENT

The Sandia Lower Head Failure of the Reactor Pressure Vessel OECD/NEA Project (OLHF) was conducted at Sandia National Laboratories (SNL) from September 1998 to June 2002 [1]. During a severe nuclear reactor accident, the lower head of the reactor pressure vessel (RPV) can be subjected to significant thermal and pressure loads. It is possible that the lower head will fail, releasing large amounts of molten corium into containment. The Three Mile Island Unit 2 (TMI-2) accident involved the melting of about 20 tons of corium, which collapsed into the lower head of the RPV. Despite the presence of water, the lower head reached temperatures of ~1880 ^{o}F for 30 minutes in an area with an equivalent diameter of three feet. During this period the reactor cooling system was at 1450 psia. The objective of this project was to investigate the timing and size of lower head failure under conditions of low reactor coolant system pressure and large differential temperatures across the lower head wall.

Although the TMI-2 vessel did not fail, code analyses conducted in the course of an Organization for Economic Cooperation and Development and Nuclear Energy Agency (OECD/NEA) TMI-2 Vessel Investigation Project (VIP) predicted creep rupture in the prevailing conditions. This implies that the then state-of-the art modelling of the lower head failure was not mature because it did not take full account of the effect of the thermal loading. These methodologies have been further developed since the TMI-VIP project to analyze existing and next generation reactors from the perspective of accident assessment, management, and mitigation. In order to improve and validate structural analysis codes, there was a need for experimental data on lower head deformation and failure phenomena.

SNL completed eight U.S. Nuclear Regulatory Commission (NRC) sponsored tests on lower head failure. These tests were specifically designed to address lower head failure issues with prototypic material and geometry. The OECD/NEA project extended the NRC/SNL low head failure program to address issues such as lower RPV pressures (representative of depressurized or partially depressurized conditions) and pressure transients. These tests also represented an improvement over previous tests by simulating a large temperature gradient across RPV of lower head wall. The temperature gradients addressed in these tests are representative of conditions without ex-vessel cooling. The participating countries included the following: Belgium, Czech Republic, Finland, France, Germany, Spain, Sweden, and the United States.

Figure 1 shows the experimental piece from this work which will be moved from TA-III to the TTD within the CGSC. The work done for the NRC and OECD/NEA was all unclassified and authorized for unlimited release.

Figure 1: Lower Head Experimental Piece

3. NAC ¼-SCALE TRANSPORTATION CASK EXPERIMENT

The experimental piece shown in Figure 2 help provide the technical basis for the NAC legal weight truck (LWT) NRC safety analysis report (SAR) [2]. The approved NAC-LWT SAR authorizes the shipment of radioactive material and for the package to be to be shipped in accordance with Title 49 of the Code of Federal Regulations (49 CFR) 173.471. This experimental piece was a ¼-scale of the NAC-LWT and subject to drop tests in accordance with 10 CFR 71.71. The work done for the NAC was all unclassified and authorized for unlimited release.

Figure 2: NAC ¼-Scale Experimental Piece

4. REFERENCES

1. Humphries, L.L., et. al., "*OECD Lower Head Failure Project Final Report*," NEA/CSNI-R(2002)-27, Sandia National Laboratories, Albuquerque, NM, 2002.

2. USNRC, "*Ltr W Fowler, NCA Intl, Revision of Certificate of Compliance No. 9225, Rev. 61, for the Model No. NAC-LWT Package (TAC No. L24706) Docket No. 71-9225*," Accession No. ML14363A412, USNRC, Washington DC, 2015.

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