

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555-0001

October 22, 2008

NRC INFORMATION NOTICE 2008-17: CONSTRUCTION EXPERIENCE WITH
CONCRETE PLACEMENT

ADDRESSEES

All current and potential applicants for an early site permit, combined license, or standard design certification for a nuclear power plant under the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," all current holders of and potential applicants for construction permits under 10 CFR Part 50, Domestic Licensing of Production and Utilization Facilities, and all licensees and potential applicants for new fuel cycle facilities under 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

PURPOSE

The United States (U.S.) Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert addressees to the importance of considering lessons learned from construction experience when planning for and constructing new nuclear power plants or fuel cycle facilities. Recipients are expected to review the information for applicability to their planned activities and consider actions to avoid similar problems. The suggestions contained in this IN are not NRC requirements, and no specific action or written response is required.

BACKGROUND

The nuclear industry in the U.S. faced many construction quality and design issues in the 1970s and 1980s. In 1984, the NRC issued NUREG-1055, "Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants," to document the lessons learned from plant construction in the U.S. (Agencywide Documents Access and Management System (ADAMS) Accession No. ML063000293). The NRC also issued IN 2007-04, "Construction Experience Related to the Assurance of Quality in the Construction of Nuclear Facilities" (ADAMS Accession No. ML063040426), to alert addressees to the importance of considering lessons learned from construction experience when planning for and constructing new nuclear power plants or fuel cycle facilities.

Recently identified problems in some domestic and international construction projects could provide new insights to the nuclear industry to understand the causal factors and to avoid similar mistakes in the future. The experiences referenced in this IN mainly focus on problems with concrete placement processes in the construction of new nuclear power plants and a fuel fabrication facility. The NRC believes this information is appropriate for consideration in the construction of any nuclear facilities.

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DESCRIPTION OF CIRCUMSTANCES

Concrete Placement Issues at Olkiluoto 3 in Finland

An investigation report, issued July 10, 2006, on the construction problems and resulting delays of Olkiluoto 3 by the Finnish Radiation and Nuclear Safety Authority (STUK), identified several contributing factors. Among them was the concrete placement of the reactor building basement. During this phase of construction, Teollisuuden Voima Oy (TVO), the licensee, detected inconsistencies in the concrete between different truckloads. TVO confirmed that the plasticizer caused the variation. Other problems involved water-cement ratios outside of design requirements and changes in the composition of the concrete made by the contractor outside of the procedural process without the licensee's knowledge. As a result, the licensee and regulator required various tests on the concrete and also investigated the construction site operations. Test results indicated that the concrete met minimum standards. Investigation of site operations indicated that this event was, in part, caused by the lack of communication, the lack of defined responsibilities, and poor quality control. Although the concrete was ultimately found acceptable, this event caused lengthy construction delays and had a negative impact on public confidence. The full STUK investigation report is available online at http://www.stuk.fi/stuk/tiedotteet/2006/en_GB/news_419/files/76545710906084186/default/investigation_report.pdf

Concrete Mixing Issues at Mixed Oxide Fuel Fabrication Facility

In September 2007, an NRC inspector at the Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) construction site observed various problems with concrete placement. Based on the applicant's rejection of five concrete truckloads due to concrete slumps being outside of the design value, the inspector performed an inspection of the concrete batch plant. During inspection at the batch plant, which was operated by a contractor, the inspector noted that chemical plasticizer and water that exceeded the manufacturer's recommendation and the design specification were added to the design mix. The addition was made without procedural guidance and was not documented. In response to the NRC inspection, the applicant, Shaw AREVA MOX Services, assumed responsibility for concrete testing at the batch plant, provided immediate quality assurance coverage of all batching operations, ensured that batch plant procedures were written or revised as necessary, and consulted independent experts for recommendations for improvement. NRC Team Inspection Report 70-3098/2007-004 is available as a public document in ADAMS under Accession No. ML073030407.

In January 2008, at the construction site of the MFFF, a concrete reinforcement steel bar failed. The reinforcement steel bar fractured near a bend location due to work hardening during the bending process. In response, the NRC conducted a reactive inspection in February 2008, which revealed problems with bent rebar, primarily in the foundation of the facility. This led to NRC inspections of the reinforcing steel vendor and the MFFF site. The inspection of the steel vendor revealed the following five nonconformances: inadequate surveillance of the fabrication of rebar, inadequate audits of sub-suppliers, failure to verify adequacy of design in the dedication of commercial grade items, failure to write a corrective action process condition report for a significant condition adverse to quality, and the failure to properly disposition a code deficiency. The MFFF inspection yielded no findings. The applicant had already issued more than 80 condition reports addressing problems with vendor parts and further increased oversight

of vendor activities. NRC Team Inspection Reports 70-3098/2008-005 and 99900866/2008-001 are available as public documents under ADAMS Accession Nos. ML081340672 and ML081410040. Additionally, NRC Inspection Report 07003098/2007-003 (ADAMS Accession No. ML072080093), provides information on nonconformance reports issued by the licensee to the steel vendor.

Concrete Placement Issues at Flamanville 3 in France

An inspection of the Electricite de France (EDF) Flamanville 3 European Pressurized Reactor construction site by the Autorite de Surete Nucleaire (ASN) in March 2008 revealed several problems with the reinforcement steel bars and concrete placement for the basemat of the fuel storage buildings. The inspection revealed improperly spliced and tied rebar, and reinforcing steel placement that did not conform to approved procedures and design requirements. Despite these deficiencies, the concrete contractor had initiated the concrete placement procedure. ASN was able to check that corrective action had been taken accordingly before concrete had actually been placed in the area. In another case, the concrete reinforcement and placement did not follow the construction specifications and drawings. A review of site conformance records indicated that some aspects of the work were flagged with specific notations as potential nonconformances, but the follow-up actions were not tracked. Accordingly, ASN requested that the licensee provide additional information. For the issue of improperly spliced and tied rebar and nonconforming reinforcing steel placement, assurances that prior concrete placements were free of inconsistencies with the design requirements were requested. In the case where implementation did not match the construction specifications and drawings, ASN requested that the licensee document and validate the alternate methods, and explain the reasons for the failure to follow approved construction procedures. ASN requested information about the causes leading to the failure to track and close deficiencies identified in field records. The letter from ASN to the licensee (in French) detailing the inspection findings and required actions can be found online at http://www.asn.fr/sections/rubriquesprincipales/actualites/lettre-suite-d/genie-civil_10/downloadFile/file/INS_2008_EDFFA3_0012.pdf

On May 21, 2008, EDF informed ASN about another nonconformity concerning the reinforcement steel of the basemat of the safeguard auxiliary buildings, specifically, a lack of stirrups. Beyond the technical nonconformance, ASN considers the main issue to be the licensee's quality management system. A preliminary analysis of the root causes indicated that the nonconformance had not been corrected before concrete placement although the lack of stirrups had been identified on time by both the subcontractors and the licensee. Consequently, ASN stopped the concrete placement activities of all buildings relevant to safety, mainly the pumping station and nuclear island basemat. ASN asked the licensee to provide detailed plans to identify managerial and organizational enhancements to support improved oversight of field activities, and to facilitate field task tracking. The licensee submitted its revised action plan, and ASN determined that it would allow the proposed improvement to the quality management system of Flamanville 3. On June 17, 2008, ASN authorized the licensee to resume concrete placement activities on all buildings except the basemat of the safeguard auxiliary buildings. For the safeguard auxiliary buildings, the licensee submitted a technical analysis of the nonconformance and a proposed correction that have been assessed by ASN. ASN then authorized the licensee to resume concrete placement activities on the safeguard auxiliary buildings in July 2008.

DISCUSSION

Both abroad and in the U.S., interest in new reactor and fuel cycle facility construction is resuming after many years. However, problems in nuclear construction, similar to those identified in the U.S. more than 20 years ago, have resurfaced. Although the technical issues vary, inspections repeatedly identify a lack of contractor oversight and poor quality control in concrete placement. A commitment to quality, applied early in a construction project, ensures that a facility is constructed and operated in conformance with its license and NRC regulations. Particular attention should be given to quality assurance program effectiveness and the implementation of 10 CFR 50, Appendix B requirements, especially when the construction work is directly related to nuclear safety and is performed by contractors. Also, concrete placement problems can be avoided by ensuring the correct installation of the rebar in accordance with the approved drawing details and complying with the applicable American Concrete Institute codes. Specifically, prevention of problems similar to those identified necessitates appropriate controls in activities such as: (1) concrete batch plant inspections and truck mixer quality checks (e.g., slump tests), (2) rebar bending, (3) concrete placement and consolidation using vibrators, (4) quality control checks of the rebar installation (prior to concrete placement), and the visual inspection of the concrete placement activities, and (5) concrete testing (e.g., cylinder samples and compressive strength breaks).

CONTACT

This information notice requires no specific action or written response. Please direct any questions about this matter to the technical contact listed below.

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Note: NRC generic communications may be found on the NRC public Web site, <http://www.nrc.gov>, under Electronic Reading Room/Document Collections

