Large Component Regulatory Relief in the United States

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1) Background

Beginning in the mid-1990s, after the U.S. Department of Transportation (DOT) and the U.S. Nuclear Regulatory Commission (NRC) adopted the 1985 International Atomic Energy Agency (IAEA) radioactive material transportation regulations domestically, organizations with nuclear power stations and test facilities began to find it increasingly necessary to transport large radioactive components for disposal purposes. The transportation needs arose due to the retirement and dismantlement of some facilities, as well as component degradation requiring replacement to provide for continued operation at other facilities.

The dismantling of retired nuclear power and test facilities required the transport of reactor vessels, reactor vessel heads, pressurizers, reactor coolant pumps, and steam generators; whereas the replacement of degraded components to continue operations has been generally limited to pressurized water reactor steam generators, and more recently, reactor heads. These components are quite large and massive, measuring up to 20 feet in diameter and 70 feet in length and weighing 50 to 600 tons.

2) Issue

Several issues arose, due to the implementation of the 1985 IAEA transportations regulations in the United States, on the practical matters of how to characterize the components and comply with the transportation regulations. The concept of a Surface Contaminated Object (SCO) was new to many in the U.S., and the large components were not readily amenable to transportation under the regulations. It was apparent that most of the components should be considered as SCO. However, it was not certain that the contamination limits for inaccessible areas could be met due to non-uniform contamination deposition; nor could the interior areas be readily surveyed without on-site dismantlement of the large component. Additionally, while the components were generally substantial in design and construction due to their use as pressure vessels under other codes, the current regulations required packages that met tests such as for stacking and free drop that would pose severe engineering challenges, prohibitive costs, or logistical difficulties during transport, due to the size and weight of the components being transported.

3) Guidance

Due to these issues, the U.S. regulators met with industry members to find a solution. A result of this effort was the issuance of NRC Generic Letter 96-07, entitled "Interim Guidance on Transportation of Steam Generators," available on the internet at http://www.nrc.gov/reading-rm/doc-collections/gen-comm/gen-letters/1996/gl96007.html. This document provided guidance on how the DOT and NRC transportation requirements would apply to the shipping of discarded steam generators, the first class of large components requiring transport, and included the following directions:

1) The components should be considered as Surface Contaminated Objects. It was recognized that although the average internal contamination of the entire component could be demonstrated to be below the required levels for inaccessible surfaces, it was determined to be impractical to measure each 300 cm^2 area of the large components' inaccessible interior. Reasoned argument and calculations should be used in these cases, taking into account dose to curie conversions, material differences, contamination deposition variance, and source term identification. If uncertainty existed that the definition of a SCO could be met, then U.S. Department of Transportation approval should be sought.

2) The maximum radiation level at three meters should be measured from the outside housing of the unshielded steam generator.

3) In order to ship unpackaged steam generators, relief from the SCO package requirements needs to be granted by the U.S. Department of Transportation.

4) If any relief from the regulations is needed, compensatory measures will be required such that an equivalent level of safety be achieved.

4) Practice

The steam generators, reactor coolant pumps and pressurizers have been typically transported in an unpackaged manner; that is the outermost shell of the component provides the packaging wall. The transport of reactor vessels and reactor heads with control rod drive mechanisms intact typically involve the use of packagings. It should be noted that the U.S. has a domestic regulatory exemption allowing strong, tight packaging if the total activity is less than an A_2 quantity, which has been used as the method of transport for some reactor heads with control rod drive mechanisms removed.

The relief requested and compensatory measures proposed by industry are based on the unique aspects surrounding the engineered transportation of these large components, and are evaluated on case-by-case basis. In practice, the relief granted by the U.S. Department of Transportation typically concerns the free drop and stacking tests required of IP-2 packages as well as the categorization of the material as SCO, when the strict definition cannot be reasonably achieved. The compensatory measures have included transportation plans, emergency plans, domestic transport limitation, administrative controls, exclusive use transport, grout injection, and Health Physics escort.

Any SCO relief requested is analysed to take into account the degree of uncertainty that the definition of a SCO can be met. The DOT position is that in a case where IP-2 packaging is required for large component transport, the relief able to be granted is from the free drop test and stacking test requirements. The complete component may be subjected to the free drop test requirements oriented in the transport position, rather than the orientation that will cause maximum damage, without the benefit of any securement devices or systems. The acceptance criteria for this test is prevention of: 1) loss or dispersal of the radioactive contents; and, 2) significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test. The demonstration of compliance must be for the entire component, including all penetration covers such as those for a transition cone cover, primary nozzles, manways, blowdown lines, level taps, and handholes. The stacking test requirement may be eliminated, if any stacking is administratively prohibited. All other IP-2 requirements continue to be required, including the general design requirements such as disabling or removing any unrated manufacturing-era installed lifting trunnions.

An additional topic addressed during the regulatory relief process concerns the accessible non-fixed contamination levels on the exterior of the component and the method to prepare it for transport. Several techniques have been employed for this matter, such as decontamination, application of fixative coatings, and shrink-wrap coverings over the body of the large component. Additionally, large components typically contain surface irregularities such as tapped holes and gaps or crevices near bolted/gasketed covers where significant non-fixed contamination can exist and application of a surface fixative is difficult or inappropriate. Preparation of these areas have included the use of caulking compounds and coating polymers.

5) Status

Although the U.S. Nuclear Regulatory Commission Generic Letter was originally prepared for and only describes transportation of steam generators, it has also provided the basis for subsequent large component transport, such as pressurizers and reactor coolant pumps. Recently, it has also provided a basis for reactor head and reactor vessel transport, although these components likely need to be classified as Low Specific Activity material due to neutron activation of the component materials. The utilization of this methodology has resulted in the successful transportation of five reactor vessels, four pressurizers, six reactor coolant pumps, and twenty-seven steam generators. Several reactor heads with control rod drive mechanisms intact will also be transported similarly in the near future.

The origination points for these large components have been distributed throughout the United States and the destination points have been disposal facilities in the States of Utah, South Carolina, and Washington as well as processing facilities in Tennessee and Pennsylvania. The modes of transport have included motor vehicle, rail, and vessel, or a combination thereof. Typical transportation distances have been 500 to 2,000 miles.

6) Conclusion

Much experience has been gained in transporting these large components. Due to the growing knowledge and experience base, it is anticipated that a proposal to the International Atomic Energy Agency transportation regulations can be submitted which will provide a customized regulatory framework for the transportation of these large components.

7) Contacts

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