

**THE QUALITY ASSURANCE
TOPICAL REPORT –
INTERNATIONAL CO-OPERATION
FOR MANUFACTURING OF
NUCLEAR PACKAGES**

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Abstract

**THE QUALITY ASSURANCE TOPICAL REPORT – INTERNATIONAL CO-OPERATION
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The paper addresses the manufacturing quality assurance (QA) concerns associated with fabrication of radioactive material packaging in one country for use in another. A case study is discussed which shows a method of implementation that has been successfully practised for casks fabricated in the Federal Republic of Germany (FRG) for use in the USA. The casks utilized are the Castor series, which are fabricated in the FRG from ductile cast iron. This material has several specialized fabrication and inspection requirements. Although international efforts, especially through the IAEA, have helped to standardize QA measures, detailed implementation can vary from country to country. A means of co-ordinating requirements between countries was required. The vehicle used to accomplish this was the Quality Assurance Topical Report (QATR), which is an administrative QA document that clearly defines the roles and responsibilities of all affected organizations. Research was performed to evaluate and compare the general QA requirements for both countries. The close correlation of requirements is documented in the QATR. In addition, a programme is described which permits the USA competent authority to depend on the FRG authority for inspection and enforcement procedures. Once a design has been approved, it is of great importance that the fabrication and inspection of any

component important to safety be properly controlled and documented. The USA requirements for these QA measures are enforced by the Nuclear Regulatory Commission (NRC). Enforcement of applicable regulations in the FRG is the responsibility of the competent authority, Bundesanstalt für Materialprüfung (BAM). As a part of the development of this QATR, NRC and BAM representatives met to establish a mutual understanding of QA philosophy and implementation. As a result of the co-operation, the QATR concept has been approved by both BAM and the NRC. A problem with manufacturing equipment in a foreign country is the need to periodically send company representatives to witness hold points and to review manufacturing records. This approach can be cumbersome in terms of scheduling activities and expensive in terms of time and travel. The methods described in the QATR provide a practical and workable alternative by permitting the BAM to serve as the purchaser (or utility) agent. The utility is only required to make one inspection trip. This approach has proved successful during the manufacture of five Castor casks for the USA. Under the conditions outlined by the QATR, it is agreed that the QA measures enforced by the BAM are sufficient to assure that the USA manufacturing requirements are met. Records and documentation developed during component fabrication are approved and controlled by BAM to provide complete evidence of conformance to specified requirements. A purchaser who takes advantage of this approach will be able to reduce and minimize schedule impacts associated with QA verification, while maintaining full confidence in the quality of the delivered product.

1. INTRODUCTION

It has become evident that nuclear B(U) packages and their construction, use, and unilateral approval have become an issue of both domestic and international interest. A portion of this concern focuses on quality assurance. Adequate quality assurance (QA) during fabrication is important for items manufactured in one country and used in another. Facilitating documents and approved programmes must be available that provide both nations with confidence that international and national requirements are being fully met.

In its totality, QA covers many areas including engineering design, testing, manufacturing, inspection, and finally operation. However, the area of particular interest to this paper is that of manufacturing. Included in this are the procedures for inspection and material testing, as well as the actual fabrication processes. To date, international efforts, particularly those of the IAEA, have been successful in standardizing QA requirements between nations. However, detailed implementation on a specific project must be carefully developed in order to fully match the practices which are known and prevail in each country. As a result, the actual QA programme used must be carefully formulated and adapted to the specific requirements of both the product, in this case the nuclear package, and the participating organizations. An approved planning and co-ordinating document is required which clearly defines the roles of the industrial participants, the user, and the competent authority in *both* nations. Correlation between national standards must be identified, as well as specific manufacturing inspections and qualifying procedures to be

used. Auditing schedules and responsibilities must be clearly defined. The facilitating administrative document that accomplishes this is called the 'Quality Assurance Topical Report' or QATR. It is a document, approved by the competent authorities in both countries, which specifically defines the roles of the manufacturer, management and auditing agencies.

The purpose of this paper is to present a case study which shows the history of the development of a QATR. Specific reference is made to the QA roles of the various participants and the areas of international co-operation. The QATR described has been approved by the competent authorities of both the Federal Republic of Germany and the United States of America. This QATR has been evaluated in actual use over the last one and a half years and proved successful.

2. GENERAL DISCUSSION

In this case study, the specific utilization of the QATR has been oriented towards the manufacturing of the Castor cask. This cask, which is manufactured in the Federal Republic of Germany, has been licensed for dry storage and has been purchased for use by a US utility.

As general information, the Castor cask employs a very cost-effective and efficient manufacturing technology. The cask body is a massive, poured and machined casting, fabricated from nodular ductile cast iron. This material has several specialized inspection requirements, specifically, ultrasonic testing of the cast body for flaws, and material testing by removal of core bar specimens in the cask wall. This ductile cast iron technology was successfully adapted during the last decade to nuclear packaging, by the Gesellschaft für Nuklear-Service mbH, or GNS, of Essen. At present, a US company, General Nuclear Systems, Inc., or GNSI, is developing this technology for US utility applications; GNSI is a joint venture of two companies - GNS (Federal Republic of Germany), and Chem-Nuclear Systems, Inc., Columbia, South Carolina (USA). Both companies are very much involved in nuclear waste handling, packaging, transport and disposal.

The Castor V is a dual purpose spent fuel storage and transport cask. It weighs 120 tons and has a capacity of nominally 10 to 11 tons of uranium as spent fuel. A topical safety analysis report (TSAR) was jointly prepared in 1984 by GNSI and GNS. Approval of the TSAR for spent fuel storage was received in 1985 from the US Nuclear Regulatory Commission. Approval was documented under Title 10, US Code of Federal Regulations, Part 72. The first Castor V was purchased by a US utility, the Virginia Power Company, in 1984 for a joint governmental (Department of Energy) testing programme. After successful testing in 1985 at the Idaho National Engineering Laboratory, Virginia Power purchased five additional Castor V's for use at the Surry Nuclear Power Station. This is the site of an independent spent fuel storage installation, or ISFSI. The Surry ISFSI is the pioneering facility for dry storage cask applications in the USA.

3. HISTORY OF THE QATR

It was recognized by both GNSI and GNS that a manufacturing QA programme with reduced manufacturing inspection requirements for the utility-purchaser would be needed. Typically it is not practical or cost effective for the US utility-purchaser to be involved on a daily basis with fabrication inspection in a distant foreign country. Detailed knowledge of Federal German standards and practices, and their relationship to US practices requires specific expertise which is difficult to acquire in the USA. Clearly a system of auditing by a trusted and knowledgeable Federal German authority was required. It was also recognized that the utility, as owner and licensee-operator, would be ultimately responsible for quality assurance. Both GNSI and GNS researched and compared the general QA requirements in the USA and the Federal Republic of Germany. The correlation of national codes and standards, such as DIN, IAEA, ASTM and ASME, were made. We found considerable comparability in both intent and practice between countries. To this end, a proposal for a joint international QA programme was forwarded to competent authorities in both countries, specifically the Bundesanstalt für Materialprüfung, or BAM, and the US NRC - Quality Assurance Branch.

In December 1984, an organizing meeting was held in Berlin (West), with GNS, GNSI, BAM, NRC and Virginia Power QA and licensing personnel participating. The purposes were:

- (1) To compare and adapt US and Federal German QA and compliance requirements for construction of nuclear safety equipment; and
- (2) To evaluate the possibility of a co-operative agreement between the NRC and BAM for ensuring the quality of NRC-licensed equipment manufactured in the Federal Republic of Germany.

The participants concluded that a workable programme of co-operation was feasible. The vehicle for this agreement was to be an approved QATR. The intent of the QATR was to establish an administrative programme which rigorously defined all organizational responsibilities. Together, GNS and GNSI prepared a QATR, which made extensive use of the existing GNS Quality Assurance Handbook. This document was specifically developed for the manufacture of safety class equipment destined for the USA. In it, reference was made to both US and Federal German codes, standards and procedures.

Submittals of the QATR were made to both the NRC and BAM. In February 1986, BAM officially concurred with the document and agreed that all processes and requirements attributed to them in the QATR would be met. In April 1986, GNSI received official NRC approval of the QATR. The approval specifically stated that "BAM and PTB (the Federal German competent authorities) activities described in the QATR will be accepted by the NRC as a substitute for inspections otherwise performed by the utility-purchaser". The NRC QA programme review

and approval was made in accordance with 10CFR72. It was noted that utilities could reference the QATR in their cask procurement and ISFSI licensing documents. To date, GNS has completed five Castor casks in accordance with this QATR and referenced programmes. These casks will be shipped to the USA in the summer of 1986 for use at the Surry Station ISFSI.

4. RESPONSIBILITIES

Generally, the simpler the plan and the fewer the number of concerned parties involved, the greater the probability of success. However, the nature of international co-operation frequently moves in the opposite direction. In this case, at least six parties in two countries are involved. However, the responsibilities defined in the QATR are being implemented according to the plan. The underlying philosophy embodied in the QATR defines responsibilities based on these three principles:

- (1) A clear division of QA roles and an understanding and agreement on responsibilities by each organization involved was established.
- (2) A defined schedule of audits by each organization is in place, with a co-ordinating project manager assigned to ensure compliance.
- (3) Each organization has one controlling document which is referenced in the QATR, which rigidly defines their actions. This document is applicable to their special function or role. The organization is thoroughly familiar with its use.

The organizations, their controlling document, and nation are shown in Fig. 1. The specific administrative roles of each organization are as follows:

- (1) *The Purchaser (Utilities – USA)* is the ultimate licensee and operator. As such, they have final responsibility to ensure that the equipment is manufactured in accordance with the NRC licence. This responsibility includes assurance of conformance to all applicable technical codes and standards. Even though a competent Federal German authority audits manufacture, the purchaser-utility must schedule a comprehensive audit of the inspection process on at least an annual basis. This audit may be in combination with other purchasers. Their controlling document is the procurement specification which is in accordance with their ISFSI Part 72 licence.
- (2) *The Project Managers (GNSI – USA)* are responsible for executive management and overall co-ordination of the fabrication project and they routinely monitor that all quality actions are in accordance with the QATR (their controlling document). They are the focal point for facilitating and ensuring liaison between all US and Federal German organizations.
- (3) *Engineering and Manufacturing Management (GNS – Federal Republic of Germany)* ensures that all manufacturing is performed in accordance with

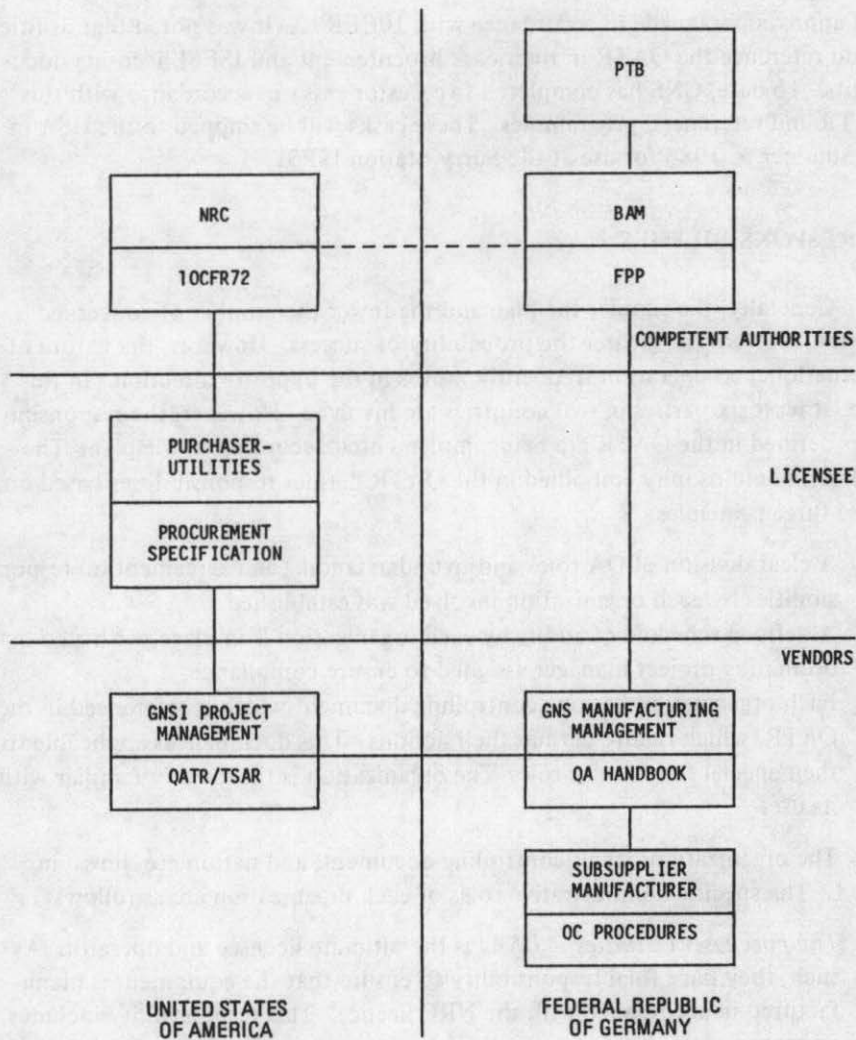


FIG. 1. Functional organization chart indicating locations, relations and controlling document.

the licensed design. They prepare procedures for special material and testing requirements. For example, ultrasonic testing of the cask body, material chemistry and toughness properties, leak testing, etc. These are critical to cask function and safety. Their controlling document is the GNS QA handbook.

- (4) *The Manufacturer (Federal Republic of Germany)*, as constructor of the cask, directly performs all inspections and testing processes. Standard factory proce-

dures are sometimes modified by special instructions, which are supplied by GNS. Their controlling documents are their QA manual and factory procedures as approved by GNS.

- (5) *The Competent Authority (PTB, BAM – Federal Republic of Germany)* is the Physikalisch-Technische Bundesanstalt (PTB). Their work is supplemented by the BAM in the area of manufacturing and testing. The BAM is responsible for compliance assurance and serves as a third party auditor for fabrication and testing. Since they are an independent agency, and familiar with Federal German inspection practices and standards, they are an invaluable substitute auditor for the utility-purchaser. They are also thoroughly familiar with IAEA requirements for nuclear transportation packaging. Their controlling document is the FPP or fabrication and test plan. This is a standard checklist form, prepared by GNS and approved by BAM. The FPP is the BAM control for auditing. BAM approves and controls the test fabrication records developed during component fabrication to provide complete evidence of conformance.
- (6) *The Competent Authority (NRC – USA)* is responsible for the QA of all nuclear equipment in the USA as it relates to the US public safety. As competent US authority, they audit, as necessary, the Quality System to ensure compliance to the approved QATR. Their controlling document is Subpart B of 10CFR72. They periodically audit the utility-purchaser to ensure compliance with their ISFSI licence per 10CFR72.

Obviously other organizations are involved, including the Federal German Ministry of Transport and the Department of Transportation (USA). Both have agreements and memoranda of understanding which utilize the expertise of their nation's competent authority.

5. EXPERIENCE TO DATE

Quality assurance of the manufacture of nuclear material packaging is a key example of needed international co-operation in the nuclear field. The Castor QATR, as presented in this case study, is a pioneering agreement. The QATR presents both a logical and workable administrative approach that all organizations can adhere to. The programme fully meets all IAEA requirements. It could serve as a framework for agreement between other nations and organizations.

The BAM role in auditing manufacture within the Federal Republic of Germany is key to the success of this process. It provides the US purchaser-utility and the NRC confidence that the package will be manufactured to the acceptable standards in accordance with the NRC approved package licence. It is also an efficient system since casks could be supplied to several US purchasers-utilities if annual utility audit requirements are met. Extensive utility costs are precluded.

The Castor QATR programme has been working successfully for over one year and through the manufacture of five casks. Based on the results of a number of component authority audits and verifications, it is a practical and workable approach. Even though the number of involved organizations is large, the programme is successful and not complex for the following reasons:

- (1) There is a defined and dedicated commitment by all parties to make the system work.
- (2) The organizational duties are well known to all parties and similar to those normally performed in their respective countries.
- (3) A clearly written administrative plan, as exemplified by the QATR, employing a project manager who is dedicated full time to this programme, ensures that co-ordination is achieved.

We trust that this case study shows that international co-operation in nuclear packaging can be successfully accomplished.

RESEARCH AND DEVELOPMENT