RL/REG-99-16
Revision 0

REGULATORY UNIT POSITION ON THE SELECTION OF DESIGN STANDARDS

July 30, 1999

Office of Radiological, Nuclear and Process Safety Regulation
of the TWRS-P Contractor

U.S. Department of Energy
Richland Operations Office
P.O. Box 550, A4-70
Richland, Washington 99352

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Approved by:______________________________

Date:____________________________________

PREFACE

In February 1996, the U.S. Department of Energy's (DOE) Richland Operations Office (RL) issued a request for proposal for privatized processing of waste as part of the Tank Waste Remediation System (TWRS). Offerors were requested to submit proposals for the initial processing of the tank waste at the Hanford Site. Some of this radioactive waste has been stored in large underground storage tanks at the Site since 1944. Currently, approximately 54 million gallons of waste containing approximately 250,000 metric tons of processed chemicals and 215 million curies of radionuclides are being stored in 177 tanks. These caustic wastes are in the form of liquids, slurries, saltcakes, and sludges. The wastes stored in the tanks are radioactive and hazardous wastes.

Using the privatization concept, DOE is purchasing waste processing services from a contractor-owned, contractor-operated facility through a fixed-price contract. DOE plans to provide the waste feedstock to be processed but will maintain ownership of the waste. The contractor must: (a) provide private financing; (b) design the equipment and facility; (c) apply for and receive required permits and licenses; (d) construct the facility and commission its operation; (e) operate the facility to process tank waste according to DOE specifications; and (f) deactivate the facility.

The Tank Waste Remediation System Privatization (TWRS-P) Program is divided into two phases, Phase I and Phase II. Phase I is a proof-of-concept/commercial demonstration-scale effort the objectives of which are to: (a) demonstrate the technical and business viability of using a privatized contractor to process Hanford tank waste; (b) define and maintain adequate levels of radiological, nuclear, process, and occupational safety; (c) maintain environmental protection and compliance; and (d) substantially reduce life-cycle costs and time required to process the tank waste. The Phase I effort consists of three parts: Part A, Part B-1, and Part B-2.

Part A was a twenty-month period from September 1996 to May 1998 that established technical, operational, regulatory, and financial elements necessary for privatized waste processing services. This included identification by the TWRS-P contractors and approval by DOE of appropriate safety standards, formulation by the contractors and approval by DOE of integrated safety management plans, and preparation by the contractors and evaluation by DOE of initial safety assessments. Of the twenty-month period, sixteen months were for the contractors to develop the Part-A deliverables and four months were for DOE to evaluate the deliverables and determine whether to authorize one or both of the Contractors to perform Part B. Part A culminated in DOE's authorization on August 24, 1998, of BNFL Inc. to perform Part B.

Part B-1 is a twenty-four month period, starting August 24, 1998, to: (a) further the waste processing system design introduced in Part A, (b) revise the technical, operational, regulatory, and financial elements established in Part A, (c) provide firm fixed-unit prices for the waste processing services, and (d) achieve financial closure.

Part B-2 is a sixteen-year period to complete design, construction, and permitting of the privatized facilities; provide waste processing services for representative tank wastes at firm fixed-unit prices; and deactivate the facilities. During Part B-2, approximately 10% by volume (25% by activity) of the total Hanford tank wastes will be processed.

Phase II will be a full-scale production effort. The objectives of Phase II are to implement the lessons learned from Phase I and to process all remaining tank waste into forms suitable for final disposal.

An essential element of the TWRS-P Program is DOE's approach to safety regulation. DOE has specifically defined a regulatory approach and has specifically chartered a dedicated Office of Safety Regulation of the TWRS-P Contractor (Regulatory Unit). The aim of DOE in proceeding with the safety regulation of the TWRS-P contractor is to establish a regulatory environment that will permit privatization to occur on a timely, predictable, and stable basis. In addition, attention to safety must be consistent with that which would accrue from regulation by external agencies. Since external regulation of safety may occur at some future date, DOE regulation should permit a seamless transition to external regulatory agencies. DOE is patterning its regulation of the TWRS-P contractor to be consistent with that of the U.S. Nuclear Regulatory Commission (NRC) for radiological and nuclear safety. For industrial hygiene and safety (IH&S), regulation is consistent with that of the Occupational Safety and Health Administration (OSHA).

The RL Manager has responsibility and authority for safety regulation. The RL Manager has assigned safety regulatory authority to the RL Director of the TWRS-P Regulatory Unit (the TWRS-P Regulatory Official). The regulatory authority of the Regulatory Official is exclusive to the regulation of the TWRS-P contractor. The Regulatory Official is the formal point of execution for safety regulation of the TWRS-P contractor.

The DOE requires the contractor to integrate safety into all facets of work planning and execution. This Integrated Safety Management (ISM) process emphasizes that the contractor's direct responsibility for ensuring safety is an integral part of mission accomplishment. Like the approach taken by NRC and OSHA, the privatized contractor has primary responsibility for safety. The DOE, through its regulatory program, is responsible for ensuring that the contractor establishes and complies with safety limits.

The relationship between DOE and the privatized contractor performing work under a fixed-priced contract is different than the relationship under traditional Management and Operations contracts. For fixed-price contracting to be successful, this different safety relationship with the contractor is accompanied by modified relationships among DOE's internal organizations. For example, the arrangement by which the RL Manager applies regulation to the TWRS-P contractor should be a surrogate for an external regulator (such as the NRC or OSHA) with strong emphasis on independence, reliability, and openness.

Regulation by the RU in no way replaces any legally established external regulatory authority to regulate in accordance with their duly promulgated regulations. The contractor is not relieved from any obligations to comply with such regulations and is subject to the enforcement practices contained therein.

RECORD OF REVISION

Document Title: RU Position on the Selection of Design Standards

Document Number: RL/REG-99-16

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SELECTION OF DESIGN STANDARDS

1.0 SUMMARY

This paper discusses acceptable methods for the contractor selection of design standards for the control of potential hazards.[1] This paper provides non-mandatory guidance that amplifies the contractual requirements of the *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for TWRS Privatization* (the Process), DOE/RL-96-0004.[2] The Regulatory Unit (RU) position is that the contractor, BNFL Inc. (BNFL), should select and confirm standards using at least seven criteria: (1) engineering experience, (2) facility experience, (3) safety specifics, (4) costs, (5) contract requirements, (6) legal requirements, and (7) reliability associated with prior use of the standard. As provided for in DOE/RL-96-0004, a RU staff member may attend meetings by the selection and confirmation teams.

2.0 INTRODUCTION AND BACKGROUND

The Tank Waste Remediation System Privatization (TWRS-P) facility[3] located on the Hanford Site is a radiochemical processing plant designed to process and to vitrify a variety of highly radioactive wastes that will be recovered from underground tanks. For the past 55 years, these tanks have been used to store wastes from the processing of nuclear fuel.

The RU has the responsibility of regulating the radiological, nuclear, and process safety of the TWRS-P facility throughout its life cycle. The history of the project and the background of the Department of Energy (DOE) contract process and regulatory responsibilities are provided in the *Concept of DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors*, DOE/RL-96-0005 and *DOE Regulatory Process for Radiological, Nuclear, and Process Safety for TWRS Privatization Contractors*, DOE/RL-96-0003.

3.0 SAFETY DESIGN PROCESS

The *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors*, DOE/RL-96-0006, provides the top-level radiological, nuclear, and process safety standards and principles for the TWRS-P facility. Among these are risk goals and probabilistic dose standards. The dose standards are in terms of a matrix of permissible radiation

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[1] A "hazard" is defined for this work in *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors*, DOE/RL-96-0006, as "a source of danger … without regard for the likelihood or credibility of accident scenarios …".

[2] "Selection," as used in this paper, refers to both the identification and confirmation of standards, described in the Process.

[3] The term "Privatization" refers to the contract by which the contractor owns and operates the facility to produce vitrified waste for the Department of Energy. The RU was established as the DOE regulator of radiological, nuclear, and process safety.

doses to co-located workers, facility workers, and members of the public from events and conditions of different probabilities. The facility design, through strategies for the control of risks of the facility, must comply with the dose standards during operation.

DOE/RL-96-0004 provides the process by which the RU expects standards to be selected to ensure that the facility complies with the governing safety requirements. This has been supplemented by *Regulatory Unit Position on Tailoring for Safety*, RL/REG-98-17, which provides a more detailed description of the process.

The steps in the process are as follows:

(a) Identify the functional requirements, the key systems, and the work activities. (Step 2)

(b) Assess the hazards of the plant. Then identify possible initiators which might lead to those hazards such as external (seismic, extreme weather, loss of off-site power, etc.) and internal (component and control failures) off-normal conditions for all significant processes in the facility. (Step 3)

(c) Describe the consequences of the accident conditions, taking into account common cause and common mode failures and the operation of equipment and instrumentation in out-of-specification conditions. Such analyses are usually performed first for unmitigated consequences to define the magnitude of the hazards to be accommodated.[4] (Also Step 3)

(d) Define control strategies for each group of accidents.[5] (Step 4)

(e) Analyze the consequences of the accidents mitigated by the selected control strategies. The accident analysis, demonstrating that the control strategies are sufficient to mitigate the hazards, will result in a set of required safety functions for the important to safety structures, systems, and components. These safety functions include specifications of capabilities and reliabilities sufficient to ensure that the design conforms with the dose standards and risk goals (DOE/RL-96-0006) for the protection of the workers and the public. (Also Step 4)

(f) Select design standards by which the important to safety structures, systems, and components will be designed to provide the required capabilities and reliabilities. (Step 5)

(g) Implement the design standards to provide the required capabilities and reliabilities. (On-going design process)

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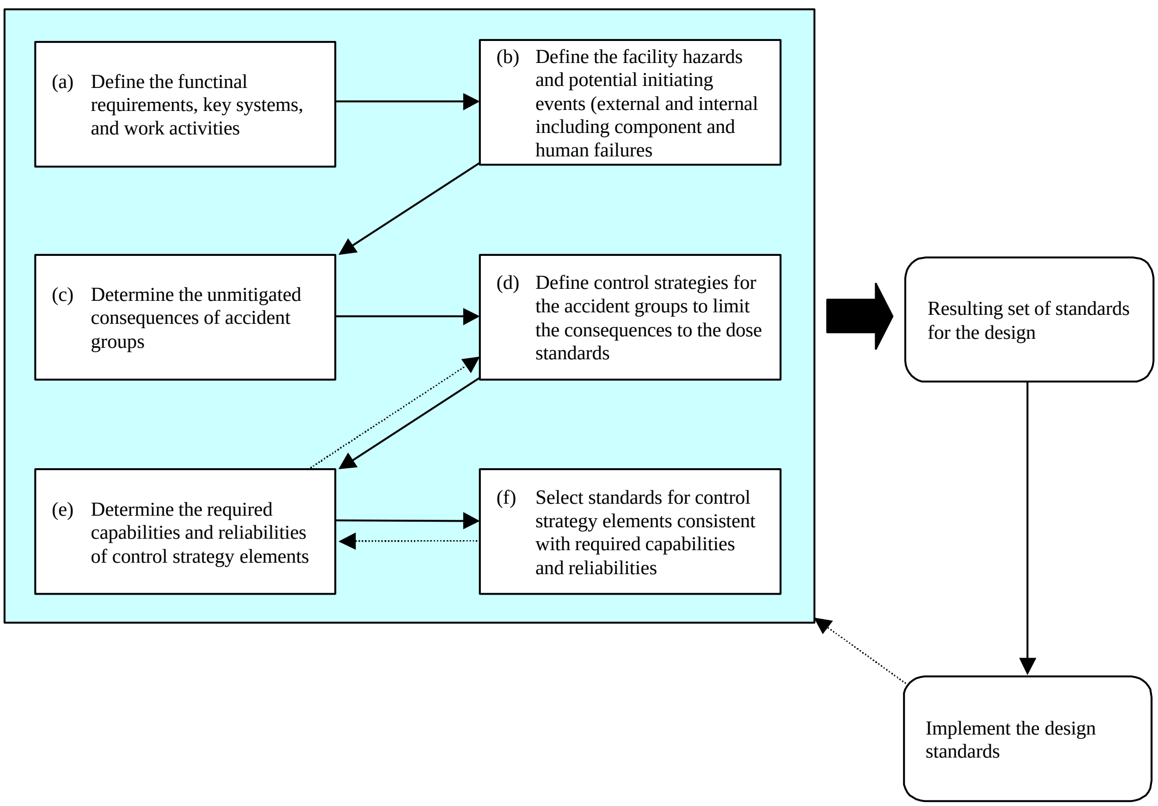
[4] Unmitigated analysis must assume failed systems so, for example, structures can only provide as much confinement as is provided by cracked concrete walls. Mitigation would assume, for example, a liner designed to remain intact during the event.

[5] Control strategies include the provision of redundant and diverse systems, the provision of confinement systems, the definition of mitigating actions, as necessary. RU guidance in defining the strategies is provided for defense in depth and for single failure criteria in both physical and electrical systems in RL/REG-98-08, *Regulatory Unit Position on Selected Hazards Control Strategy Issues*.

The RU provided an example of a partial implementation of this process, steps (a) through (e), for the boiling of a Technetium and Cesium storage tank in the Standards Identification Exercise, RL/REG-98-13. RL/REG-98-13 also provided possible general criteria for the selection of standards.

Although the standards selection process steps are given in a sequence above, the process is iterative since the first control strategies selected in step (d) may well not be adequate or components cannot be designed and fabricated to a sufficiently high reliability. Further, in order to perform step (e), it is necessary to estimate reliability for certain components such as piping, cranes, pumps, or instrumentation. The assumed reliability is dependent in turn on the manner in which the components were designed: that is, on their design standards, which are the subjects of a later step (f) in the process. Thus, steps (d), (e), (f), and (g) are connected. These connections are illustrated in Figure 1.

Figure 1. Technical Steps in the *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for TWRS-P*, DOE/RL-96-0004.



4.0 STANDARDS DEVELOPMENT AND USE

4.1 U.S. STANDARDS

Consensus standards developed by professional societies such as the American Nuclear Society (ANS), the American Society for Mechanical Engineers (ASME), the American Society for Testing and Materials (ASTM), and the Institute of Electrical and Electronic Engineers (IEEE) are consensus standards. The choice of members of a standard development committee is very carefully controlled by the professional societies to the requirements of the American National Standards Institute (ANSI). ANSI criteria ensure that membership includes a balance of interested suppliers or users as well as independent experts in the subject. These members must have the required formal qualifications, training, and expertise in the subject of the standard. Members of regulatory bodies are generally not included, other than as observers, so that those bodies can later approve or deny the standard or generate an equivalent regulatory standard. The final standard undergoes peer review for both content and use as a standard.

The consensus committee balances safety requirements qualitatively against cost or performance or maintenance disadvantages based upon their experience. Although the application of different design margins, different design configurations, and different quality-control procedures will result in different reliabilities in operation, such considerations are not evaluated numerically by a consensus standards committee. Therefore, it is impossible to select a standard on the basis that it provides a specific numerical reliability. Moreover, consensus standards often include flexibility for the designer to adopt different options depending on the level of assurance required by the component in the expected operating environment without a numerical scale of reliability.

Approval for the use of a standard and its specific implementation in the design remains the prerogative of the regulatory authority. For this project, the RU is the regulatory authority for approval of radiological, nuclear, and process safety standards proposed by the privatization contractor. The RU is obligated to approve standards that provide adequate safety (i.e. were derived from an integrated safety management process described in DOE/RL-96-0004), comply with existing regulations such as 10 CFR 835 and 830.120, and conform to the top level standards and principles (DOE/RL-96-0006).

4.2 BRITISH STANDARDS

The British Standards Institute (BSI) provides consensus standards in the same manner as in the U.S., for many applications including engineering design. Interpretive guides for their application are available for very specific applications. For example, the quality standard

BS 5750[6] can be applied to different applications such as piping, food and catering, or nursing. The equivalent nuclear standard is BS 5882.[7]

The BSI nuclear quality standard was originally based on U.S. standards, just as the BSI vessel design requirements are based upon the earlier U.S. ASME Boiler and Pressure Vessel Code (which was based upon first-hand experience with boilers in Mississippi steamers).

A British (or Canadian) licensee can propose individual methods of complying with general safety regulations. Thus, a licensee will select a set of design codes and generate Codes of Practice, which are equivalent to appropriate sections of the Codes of Federal Regulations to a U.S. licensee. These Codes of Practice take on the force of law to the UK licensee once the regulator, the Nuclear Installations Inspectorate (NII), approves them. The Codes of Practice include not only general requirements such as BS 5882 but also very detailed and very specific Design Guides to prescribe design requirements by ‘recipe’.

The Codes of Practice provide for regulated and approved design down to the last nut and bolt. BNFL's parent company based its Codes of Practice (its proprietary Vessel and Piping Design Manuals) upon the ASME Boiler and Pressure Vessel (B&PV) Code.[8]

4.3 STANDARDS APPLICATION

The ASME B&PV code[9] provides both mandatory and non-mandatory requirements. There is flexibility for the designer, the user, and the regulator depending upon the vessel and its conditions of service. For example, “The user or his designated agent shall establish the design requirements for pressure vessels, taking into consideration factors associated with normal operation and such other conditions as startup and shutdown. Such consideration shall include but not be limited to (1) the need for corrosion allowances, (2) the definition of lethal services, (3) the need for post-weld heat treatment … dependent on service conditions, and (4) … the need for piping, valves, instruments, and fittings to perform the functions …”[10] This direction is not entirely prescriptive.

However, the definition of “lethal services”[11] refers to “poisonous gases or liquids of such a nature that a very small amount of the gas or of the vapor of the liquid mixed or unmixed with air is dangerous to life …” When lethal services are part of the service conditions most of the design and quality requirements then become mandatory and prescriptive.

Thirty (30) mandatory appendices to the B&PV code describe details of design formulae, weld examination (magnetic particle adhesion, liquid penetrant, ultrasound) and acceptance testing.

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[6] BS 5750 Quality Systems, Part 1, Specifications for Design/Development, Production, Installation and Servicing, British Standards Institute, United Kingdom.
[7] BS 5882 Nuclear Quality Systems, British Standards Institute, United Kingdom.
[8] ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 1998.
[9] Ibid.
[10] Ibid, U-2, page 3.
[11] Ibid, UW-2, page 113.

Nineteen (19) appendices provide a choice for the designer through non-mandatory but suggested good practice and examples.

4.4 DESIGN GUIDES

BNFL design guides contain mandatory practices that the company has decided are appropriate for the radiochemical conditions of service of its facilities. These design guides are comparable to the non-mandatory requirements of the ASME B&PV code. They are included in the UK Company's Codes of Practice and they have the force of law once they are approved by the UK regulator. In the U.S., design guides are typically interpreted as the selected implementation of non-mandatory recommendations of the standard.

5.0 SELECTION OF STANDARDS

5.1 SAFETY CONFIGURATION

As noted in Section 3.0, the designer is required to address capability and reliability requirements for achieving the control strategies. If a vessel and its piping have to remain intact then its reliability must be higher than for a concrete structure which could fail but still could provide some filtering of the effluents. However, as noted in Section 4.0, consensus standards do not usually provide design requirements for achieving specific reliability ranges. Even where the highest reliability is required, for 'lethal services', reliability ranges or expected failure rate maxima are usually not given.

Some of the numerical design limits are however based on probabilities of failure. For example, in the design of a vessel, the "combined membrane and bending allowable design stress is limited by two-thirds of the yield stress at design temperature."[12] This limit is set as a 2 or 3 standard deviation margin-to-yield under stress at the defined service conditions. This margin provides 95% or more confidence that the component material does not fail from the particular stress pattern. This could be used as input data in assessing the reliability of a component if this stress pattern were the most critical condition (the weak link). Similar stress limits exist in the design of components such as piping, nozzles, and valves. While these criteria are based on probability they do not provide a basis for selection between standards.

None of the published interpretations of the ASME B&PV Code address any reliability issues or failure rate data. This is typical of consensus standards. It is usually not possible to select a standard directly to provide a given design reliability.

In general, the standard selected should be associated with a design and control strategy based on failure-rate experience associated with prior use of the particular standard. A comprehensive failure-rate data-bank available for radio-chemical applications similar to TWRS-P is the BNFL

[12] Ibid, Appendix 13, Rectangular Cross-Section Container, page 426.

plc. UK data bank.[13] However, because the database is proprietary, it has not been validated by the RU. To use this failure data in design, it would be necessary, after validation, to select the data applicable to specific facilities and components in the specific service conditions that the TWRS-P design will experience. If none are available, it might be possible to interpolate or extrapolate failure data from sets of data at slightly different service conditions. Alternatively, for components or systems designed using U.S. nuclear or chemical industry practice, databases such as those in Savannah River Generic Data Base Development, Evaluation of Loss of Offsite Power Events at Nuclear Power Plants: 1980 – 1996, and Handbook of Human Reliability Analysis with emphasis on Nuclear Power Plan Applications – (Technique for Human Error Rate Prediction), may provide applicable failure data for use in establishing reliability estimates.

The selection of a standard together with its failure-rate experience is an idealized concept because most failure data applies to a unit or component in operation which is subject to a number of standards. For example, a crane's failure rate applies to machinery which has been designed and constructed to a specific set of standards while being maintained and operated to other standards or procedures by operators subject to specific training standards. If the crane fails, it could be due to a combination of weaknesses in these standards or misapplication of the provisions of the standards.

5.2 CONFIGURATION CONSIDERATIONS

The design configuration portion of the control strategy is likely to be more important to achieving adequate safety than the selection of specific design standards. Variations in configurations are likely to bring greater and better defined benefits. A configuration may be selected to simplify a control strategy and, thereby, make the selection of design standards less critical. Configuration in this sense includes:

- Administrative and physical limits on the inventory of toxic or heat producing materials.
- Passive versus active safety features such as in cooling, material transfers, criticality control, and significant instrumentation.
- Fail-safe components.
- Defense in depth – including double confinement of hazardous materials.
- Attention to the single failure criterion for both mechanical components and electrical systems.
- Redundancy – especially in power supplies which can govern the use of active safety features, instrumentation and interlocks.

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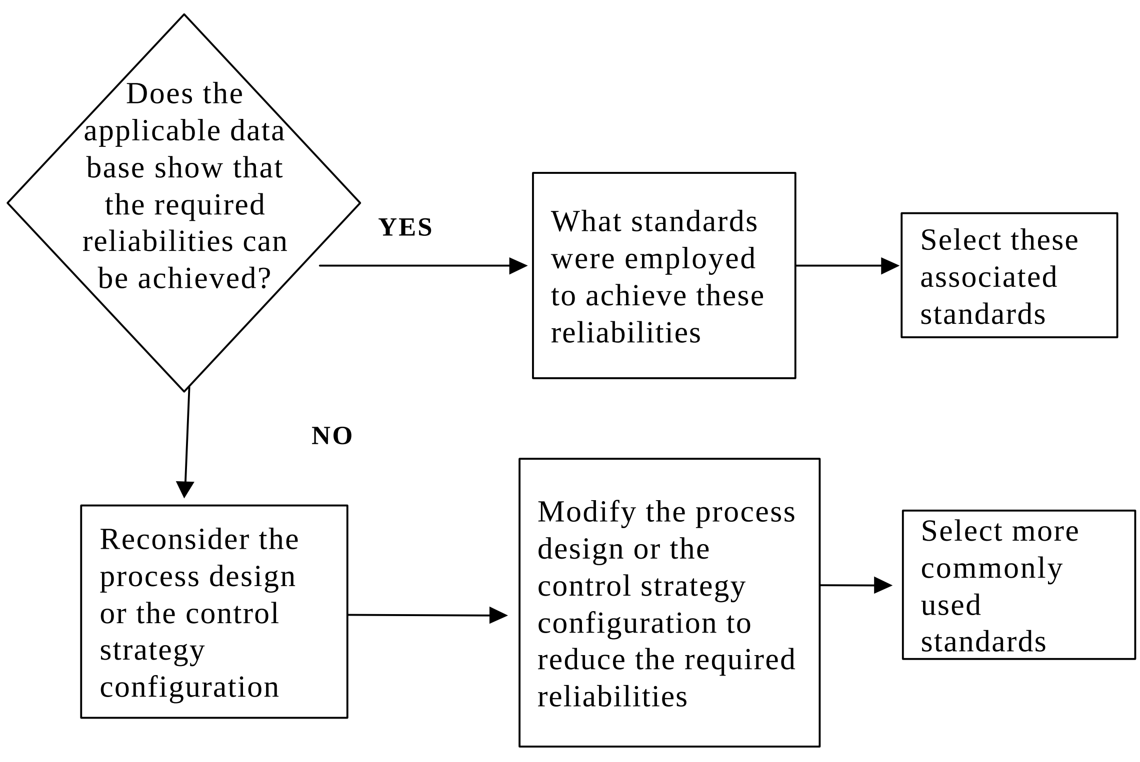
[13] Sellafield Reliability Database, Version 3.0, BNFL plc., July 7, 1998.

- Diversity in design -- paying attention to potential common cause and common mode failures.
- Automatic versus manual operation (which involves human reliability in accident conditions).
- Margins to failure in critical components and supports.

For standards selection purposes, the interplay between reliability and configuration can be addressed using the following logic. First, the accident and the control strategy configuration are defined. Then, the necessary capabilities and reliabilities to maintain doses within the matrix of acceptable doses are determined. The next question [at step (e) in Figure 1] should be, “Does the applicable failure-rate data bank show that the desired reliabilities can be achieved?”

If the answer is “Yes”, the next question is “What standards were employed to achieve these failure rates?” If the answer is “No” it would be necessary to reconsider the process design or to reconsider the configuration of the control strategy so as to reduce the required reliability of any single component or item. This process is illustrated in Figure 2.

Figure 2. Standard Selection Decision Tree.



For the safety examples presented by BNFL in *Tank Waste Remediation System Privatization Project – Design Safety Features*, the data for the reliability analysis of the control strategies is extracted from five data-bases.[14] This data comes from four locations published over the past 16 years in both the UK and the U.S. It is clear from the origin of the references that DOE Orders, U.S. Nuclear Power Plant standards approved by NRC, and British standards, all were included in the base of potential standards for this reliability information. In particular, the Savannah River Generic Data Base Development is applicable to a DOE operation when DOE Orders were the applicable standards.

When appropriate failure-rate data is not available there is also the option of generating data through testing. In this case, a design, construction, or operating standard could be used and the facility operated under down-rated conditions while experience is collected on its reliability.

6.0 RU POSITION

Given the proceeding considerations, the RU position is that BNFL's process of standard selection should be sufficiently documented to show the basis for standards selection, as described below.

Consistent with DOE/RL-96-0004, standards should be selected by a team that is composed of persons with appropriate experience and skills. That team should consider these factors in selecting standards:

Reliability:	Will the standards selected provide the reliability derived from the accident analysis and required in the selected control strategy?
Engineering experience:	What selection would a qualified engineer make on the basis of his own skilled experience?
Facility experience:	What selection would be made on the basis of prior experience of designing and operating facilities of this type? (BNFL was selected for this work in part on the basis that the Company had experience in operating similar facilities.)
Safety specifics:	What selection would be made based on the specific control strategy selected?

[14] Sellafield Reliability Database, Version 3.0, BNFL plc, July 7, 1998; Savannah River Generic Data Base Development, WRSC-TR-93-62, C. Blanton and S. Eide, Westinghouse Savannah River Company, June 30, 1993; Evaluation of Loss of Offsite Power Events at Nuclear Power Plants: 1980 - 1996, NUREG/CR-5496, C. Atwood et al, Idaho Engineering and Environmental Laboratory, November 1998; Common-cause Failure Parameter Estimations, NUREG/CR-5497, F. Marshal et al, Idaho Engineering and Environmental Laboratory, October 1998; Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications – (Technique for Human Error Rate Prediction), NUREG/CR-1278, A. Swain and H. Gutman, Sandia National Laboratories, August 1983; Accident Frequency/System Reliability analysis for Loss of Cooling to the Cs Storage Vessel, SIN-99-00002, Alan M. Kolaczkowski, TWRS-Safety Implementation Note, Scientific Applications International Company, RPT-W375-Rv. 00001, Revision 1, February 12, 1999.

Cost:	What are the costs of using this standard – are there equivalent standards that result in the required reliability of lesser cost? For example: Quality control involving 100% radiography might be too expensive and unnecessary.
Contract Requirements:	Does the standard selection comply with requirements set by the contract[15] and approved by the RU which are in addition to those addressed in the specific control strategies?
Legal Compliance:	Does the standard that has been selected comply with applicable laws and regulations?

Such considerations, where they apply, should be documented to demonstrate which of these criteria governed the selection of the standards. The considerations are inherently qualitative and depend mostly on good engineering judgement. Not all the criteria will apply to the selection of each standard. The following table suggests questions that may arise and examples of qualitative conclusions that might result from addressing the above list of criteria.

Given this qualitative nature, it is also important to the openness and reliability of the regulatory process that the RU review and observe the process of standard selection (as part of its inspection program).

[15] Contract DE-AC06-96RL13308 between BNFL Inc. and DOE, dated August 24, 1998.

Consideration	Primary Questions	Secondary Questions	Examples – Piping or IC
Engineering experience	What selection would the qualified engineer make based on his own skilled experience?	What standard generally applies to this application? Are there unusual or unique service or environmental conditions? Has the standard resulted in designs with positive operational experience? Is there experience with implementing the standard?	A piping engineer might be more familiar with non-nuclear U.S. chemical process standards or U.S. nuclear standards such as the ASME B31.3 1996 Process Piping, Category M
Facility experience:	What selection would be made by the project manager on the basis of prior experience of designing and operating facilities of this type?	Is there experience with implementing specific standards? Have the standards been used before for similar facilities?	A project manager would bring Sellafield experience of the design of radiochemical piping systems and familiarity with the BNFL plc. Piping Manual
Safety specifics	Is the structure, system, or component part of a control strategy?	What selection would be made based on the specific control strategy selected? What are the specific service or environmental conditions? What is the significance of an insufficient or unreliable design?	Coils in the Cs storage tank would require the highest margins in design for stress loads and material aging -- perhaps extra material
Costs	What are the costs of using this standard?	Are there equivalent standards that result in the required reliability at lesser cost?	When piping is not part of control strategy components, margins might be relaxed or a less restrictive standard selected
Contract Requirements	Does the standard selection comply with other engineering requirements set by the contract (Reference 3)?	Does it require a redundant, diverse or passive feature? Does it address common mode or common cause issues? What are the radiation protection issues? What are the operational, maintenance, decontamination and decommissioning implications? What are its human interface implications?	Standards for instrumentation probes may include redundant boundaries IC standards may define protection against common grounding or separation of safety functions Additional standards may be necessary to address the decommissioning of contaminated and sealed units A standard may be needed to ease human control
Legal Compliance	Does the standard selected comply with applicable laws and regulations?		The control strategy may require supplementary OSHA or EPA standards to cover special maintenance needs or recovery actions
Reliability	Does the selected standard provide the reliability assumed by the control strategy?	What are the reliability implications – does it have an associated database? Is the required reliability greater than that for standard industrial applications?	Using this standard guarantees failure rates low enough to meet the dose standards

7.0 REFERENCES

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8.0 ACRONYMS

ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
B&PV	Boiler and Pressure Vessel
BNFL	BNFL Inc.
BSI	British Standards Institute
DOE	U.S. Department of Energy
IEEE	Institute of Electrical and Electronic Engineers
NII	Nuclear Installations Inspectorate
TWRS-P	Tank Waste Remediation System-Privatization
RU	Regulatory Unit

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