NRC FORM 658
(9-1999)

U.S. NUCLEAR REGULATORY COMMISSION

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DATE OF MEETING
06/29/2000

The attached document(s), which was/were handed out in this meeting, is/are to be placed in the public domain as soon as possible. The minutes of the meeting will be issued in the near future. Following are administrative details regarding this meeting:

Docket Number(s)	**PROJECT NO. 669**
Plant/Facility Name	**EPRI**
TAC Number(s) (if available)	
Reference Meeting Notice	**MAY 19, 2000**
Purpose of Meeting (copy from meeting notice)	**TO DISCUSS EPRI REPORT TR-110689, "ROBUST PROGRAM TECHNICAL REQUIREMENTS FOR NUCLEAR FUEL PERFORMANCE**

NAME OF PERSON WHO ISSUED MEETING NOTICE	TITLE
L.N. OLSHAN	**PROJECT MANAGER**

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PD II-1

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DF03

EPRI Technical Requirements Document
NRC Discussion

Washington

June 29, 2000

Representing Robust Fuel

Rick Rohrer, NSP

Ron Gribble, Duke

Background

- One of RFP initial tasks
- Many deliberations over level of detail and use of document
  - High level performance requirements, not a design spec.
  - It is a performance and commercial document, not a regulatory document. The "Industry Guide" (WG2) is the regulatory document.
  - Utilities and suppliers do not agree on all points.
  - Competing technical requirements (such as F/R length) (Re: pg 1-3).
- Document use (Pg 1-1):
  - » Utilities to consider using some points with their fuel suppliers in bid specs, bid evaluations, etc.
  - » Optional; allows for utility differences.

TRD Objective

- To identify challenging-yet achievable-performance requirements for nuclear fuel that will ensure adequate margins.
- Identify the means for determining whether desired performance requirements are being met.
- Use document to direct and assess RFP (hot cell scope and evaluation of results)

(Re: Report summary/background, pg v)

TRD Contributors

- Utilities represented on Drafting Committee:
  - US: CP&L, ComEd, Duke, NSP, NUSCO,PECO, SNOC, STP, TVA
  - Overseas: EDF, Vattenfall
- Additional utility review & comments from:
  - Ameren-UE, British Energy, Entergy, NYPA, TXU
- Fuel suppliers on Drafting Committee
  - Active participation from: ABB-CE, FCF (including Framatome - France), GE, W
  - Verbal comments from: SPC
- Consulting support:
  - Bob Duncan (principal author),
  - Harold Klepfer, John Rivera, Dion Sunderland

Expectations for Robust Fuel (Products)

Robust Fuel should have:

- No impact on plant operation
- Capable of high duty and extended burnup with sufficient margin
- Capable of operating in any core position to target burnups
- Minimal impact on mixed core margins
- Reliability demonstrated through testing

TRD - Format

- Requirements presented in three-parts
  - Requirement description
  - Metric (how to determine if requirement has been met)
  - Rationale (reason for requirement)
- Basic rules:
  - Requirement described at a “functional” level
  - Metric should be precise and measurable
  - Rationale
    - » Explains basis for requirement
    - » Preservation of knowledge

Format Cont'd

- NOT ALL REQUIREMENTS OR RECOMMENDED PRACTICES, PROCESSES ARE IN REQUIREMENTS TABLE. Some very good items "buried" in Ch 1, Overview (especially 1.3). (Cover later)
- Refer to pg 2-2, note "Related Requirements"
- Refer to pg 2-14, note the Operating Domain Restrictions
- Refer to pg 2-16 to PIE Method Development Needs

TRD-Examples of New Requirements

Fuel Design Changes

Re: pgs 1-6,7

- Supplier to proactively predict all important performance-controlling parameters (oxide, steaming rate, etc) for each cycle, trend PIE results, recommend surveillance programs to prevent surprises from oxide spallation,crud, etc.
- Item B LTA scope, 8 FAs, different Rxs, different locations.
- Item C.
  - BU steps >5 mwd/mtu should be designated as LFAs
  - FAs with more severe duty should be designated as LFAs.

TRD - Examples of New Requirements (Continued)

Fuel Duty

- Irradiation power history is a key factor determining fuel behavior.
- Qualifying fuel to high duty requirements provides global protection against corrosion failures, rod internal pressure/cladding liftoff, DNBR, etc.
- Specification of a single prescriptive fuel duty requirement is unrealistic (differing plants/fuel, operating strategies).

TRD - Examples of New Requirements (Continued)

Fuel Duty (Cont'd)

PWR: Power histories that result in 55 to 60 GWd/MTU maximum assembly average burnup in two 18 month cycles (480 to 510 effective full power days/cycle), with up to 35 GWd/MTU in one cycle. PWR reference parameters are for a "Hot" plant with 620 F core average coolant exit temperature and significant sub-cooled boiling.

BWR: Power histories that result in 45 GWd/MTU maximum assembly average burnup in two 24 month cycles (660 to 690 effective full power days/cycle), with up to 25 GWd/MTU in one cycle. BWR reference parameters are for high power density (>50kW/l) plants.

Re: pg 1-11

TRD - Examples of New Requirements (Continued)

Fuel Duty Cont'd

Approach: Specified these burnup rates as reference conditions. They are not hard requirements because plant conditions, cycle length, etc differ. However they are to be used to:

- communicate utility fuel duty expectations with suppliers for future products.
- scope irradiation campaigns for RFP poolside or hot cell exams (as possible)
- Suppliers to extend hot cell results on future products analytically to reference conditions by analysis and evaluate results).

TRD - Examples of New Requirements (Continued)

Cladding Corrosion (Requirement 1.21. 1))

- Focuses on irradiated cladding strain capability (tensile tests) rather than simple numerical limit on oxide thickness.
- Two tiered: if hot cell data (above) not available, fall back to more prescriptive numerical requirement on oxide thickness or cladding hydrogen concentration.
- Point: focus on loss of ductility, not oxide thickness.

Oxide Spallation & Pitting (1.2.1 2))

- Surveillance inspections on LFAs under limiting conditions to ensure cladding is not susceptible to spallation.
- Note: "Operating Domain Limitations (utility and vendor actions)

BWR Channel Lifetime

- Channels must last for the life of the assembly (No channel replacement). (Very significant challenge for BWR suppliers.)

TRD-Examples of New Requirements (Continued)

Various mechanical items.

- Requirements 1.2.4 1) Pg 2-17 Specific expectation that PCI failure rates for BWRs is < 1/million (ppm). Also defect free defined in "Definitions" as 1 ppm.
- Requirement 1.2.4.1 3) Statement that PCIOMRs for non-liner and if recommended by supplier for barrier fuel. (indication of flexibility/different philosophies among utilities; non-prescriptive)
- Fuel Assembly Mechanical Interface Compatibility (2.1)
  - material compatible with plant
  - control of activation products
  - features to prevent hangup/misloading
  - FA hold-down forces

TRD-Examples of New Requirements (Continued)

Various Mechanical Items Cont'd

- 2.1.4 Dimensional stability (numerical FA growth limit and IRI).
- 2.1.5 1) Debris features and "sump screen" mesh size
- 2.1.6 1) Fastener design, NDT (e.g. HD spring screws)
- 2.2.1 GT Distortion, surveillance, FA shoulder gap
- 2.4.1 2) Grid hangup and surveillance (corrosion, cell sizes, damage)

TRD-Examples of New Requirements (Continued)

- BWR channels (2.3, pg 2-42)
  - Distortion
  - Channels to be designed to be usable for life of FA.

TRD - Examples of New Requirements (Continued)

Hydraulic Testing--Flow Induced Vibration (2.1.3, pg 2-30)

- Extent and type of testing dependent on hydraulic impact of design change.
  - Changes with minimal hydraulic impact: "Uniform Core" tests (Four sided box configuration) OK
  - Changes with greater hydraulic impact - require dual assembly "Mixed Core"tests (e.g.. transition to IFM from non-IFM) or bounding in-reactor experience. (See item 2)
- For PWRs added requirement to test for resonances over:
  - full flow range anticipated
  - cell sizes
  - frequencies to cover vibration range for rods, fuel assembly and all vortex shedding resonances

TRD - Anticipated Benefits

Utilities

- May include some or all requirements in bid specs & bid evaluations
- May use to evaluate new fuel products / extent of their testing and demonstration
- Clearer understanding of when planned operation will be outside of current successful performance operating domain
- Use to identify in advance of accepting a new product proposal the poolside PIE campaigns that will be needed at their site
- Rationale statements provide some background for new utility personnel.

Suppliers

- Receive clearer and more consistent expectations from utilities.

RFP

- Planning document for poolside and hot cell measurement campaigns
- Use for measuring success of program

Some Utilities Planning to Use the TRD

- Duke Power: input to MOX spec.
- NSP: Help prepare bid specifications and to evaluate bids
- SNOC: for routine evaluations of proposed fuel design changes, guideline for review of supplier's design packages and follow up questions to ensure good performance.
- TVA (BWR): Considering use in requests for proposals for fabrication services.
- TVA (PWR): Recently used appropriate sections of document to evaluate a design change. Found design change processes outlined in Appendix D to be very helpful.

TRD - Potential Implications

- More extensive testing and surveillance
- Closer cooperation between utility and their fuel supplier
  - Utility oversight of design change validation
  - Supplier feedback on the effects of anticipated conditions under which fuel will be operated
- Potential cost implications
  - Potential large savings in avoided costs
  - May result in increased up-front costs (testing, LTA programs, evaluations)