DUKE COGEMA
STONE & WEBSTER

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DCS-NRC-000083

Subject: Docket Number 070-03098
Duke Cogema Stone & Webster
Mixed Oxide Fuel Fabrication Facility
Construction Authorization Request
Clarification of Responses to NRC Request for Additional Information

As part of the review of Duke Cogema Stone & Webster's (DCS') Mixed Oxide Fuel Fabrication Facility (MFFF) Construction Authorization Request (CAR), NRC Staff requested clarifications of DCS' responses to NRC's Request for Additional Information (RAI). These clarifications were discussed during a series of teleconferences and on-site reviews between NRC Staff and DCS. The majority of the clarifications are noted in the NRC on-site review summaries from A. Persinko to E. Leeds dated 03 November 2001, 06 November 2001, and 18 December 2001, and from T. Johnson to E. Leeds dated 30 January 2002. DCS provided part of the requested information by letters DCS-NRC-000074 dated 05 December 2001 and DCS-NRC-000081 dated 07 January 2002.

Enclosure A to this letter, which contains non-proprietary information, provides additional responses to NRC clarification requests. The responses which include proprietary information are being provided by separate letter, DCS-NRC-000082. The responses address clarifications regarding material handling, nuclear criticality safety, confinement/ventilation, human factors, instrumentation and control, safety analysis and chemical safety, and fire protection. Additionally, the response clarifies a response related to the seismic qualification of mechanical equipment provided in the 07 January 2002 letter. A listing of remaining action items is provided in Enclosure B. If you have any questions, please contact me at (704) 373-7820.

Sincerely,

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Enclosures: A. Responses to NRC Clarification Requests
B. Remaining Clarification Items

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Enclosure A
Responses to NRC Clarification Requests

HEAVY LOADS/MATERIAL HANDLING

Clarification Requested:

DCS committed to provide clarification related to material transport systems on the release fraction for respirable plutonium {06 Nov 2001 item 1C}.

Response:

DCS provided a response related to equipment that may contain greater than 50 micrograms of respirable plutonium by letter dated 05 December 2001. The information related to the release fractions used in safety analyses was provided in the response to NRC's Request for Additional Information (RAI) 61 dated 31 August 2001. This was discussed with the reviewer in a teleconference call 23 January 2002 and no further information was required from DCS at this time.

Enclosure A
Responses to NRC Clarification Requests

ELECTRICAL/MECHANICAL

Clarification Requested:

RAI 159: Regulatory Guide 1.100 addresses seismic qualification of electric and mechanical equipment. DCS has committed to IEEE Standard 344-1987 for seismic qualification of electrical equipment. DCS will clarify its commitment to Regulatory Guide 1.100, including providing design basis information with respect to seismic qualification of mechanical equipment {03 Nov 2001 letter, item 8D}.

Response:

An addendum to the response provided by letter dated 07 January 2002 is provided below. In recent discussions with NRC staff, it was determined that the previous response did not specifically identify that the response applied to mechanical equipment. Therefore, DCS is providing a revised response as follows:

Seismic qualification of MFFF mechanical equipment meets the guidance of Regulatory Guide 1.100. The Basis of Design for mechanical equipment invokes IEEE 344 - 1987 and satisfies NRC additions to the 1987 IEEE standard stated in Regulatory Guide 1.100. Therefore, mechanical equipment seismic qualification must consider attached piping loads, thermal loads and live loads such as fluid sloshing, and in addition, applied loads are required to meet or exceed accelerations corresponding to their installed location.

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Clarification Requested:

RAI 80/81: DCS stated that its response relating to the use of either reliance on geometry control or dual parameter control would be clarified. In the case where geometry is the sole controlled parameter, DCS will still meet double contingency by ensuring that no single credible change in process conditions can produce a criticality. DCS further asserted that if there is no credible means for geometry to change, there is no need for further controls. NRC agreed that this meets the wording and intent of the DCP {03 Nov 2001 item 3G}.

Response:

The response to RAI 80 is completed (bolded) as follows:

"...As shown in Tables 6-1 and 6-2, criticality control in many locations in the MFFF is by the preferred passive geometry control that is implemented by design.

This preference for passive geometry control meets the double contingency principle which states that process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. In the case of geometry control, there are no credible changes in process conditions which can occur causing a criticality. This type of criticality control is most often used in storage areas as well as throughout the aqueous polishing process where the geometry of the unit is fixed by design and therefore can not change. In those cases, the unit is safe for all credible combinations of fissile material mass, density, moderation, reflection, etc.

In other cases, such as shown in Table 6-2 in the powder area, geometry control is not practical due to the changing geometry that results from the process. That is, there exists a variety of hoppers, scales, conveyors, mixers, and locations of material containers each with a varying geometry. In those cases, both mass and moderation is each controlled such that no single failure will result in a criticality. However, it is obviously important to control both of these parameters. **In the MFFF design, dual independent, robust controls along with passive design features are used to perform criticality control.** "

In addition, the following information are provided as a clarification to the response to RAI 81:

"As shown in Table 6-1, criticality control in most locations of the AP process is by the preferred passive geometry control that is implemented by design.

This preference for passive geometry control meets the double contingency principle which states that process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. In the case of geometry control, there are no credible changes in

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process conditions which can occur causing a criticality. This type of criticality control is used throughout the aqueous polishing process where the geometry of the unit is fixed by design and therefore can not change. In those cases, the unit is safe for all credible combinations of fissile material mass, density, moderation, reflection, etc.

In a few other cases in the AP process, where, for example significant quantities of Pu are not expected, other control methods, such as concentration control are used. In these few cases, dual independent, robust controls are used to perform criticality control.

CONFINEMENT/VENTILATION

Clarification Requested:

RAI 144 requested justification for not enclosing the furnaces in gloveboxes. The response provided by DCS was proprietary and not included in the redacted version of the DCS response to the RAI. During the meeting, DCS stated that the glovebox is not used because of maintenance reasons and because the environment in the glovebox does not make enclosing the furnace necessary. DCS agreed to evaluate this issue further and to provide justification in a letter to NRC {03 Nov 2001 item 6}.

Response:

The response to RAI 144 is revised as follows (bolded):

" A primary design function of the sintering furnace is to provide primary confinement during and after all design basis events, which includes earthquakes and maximum pressure events. In addition, events that could result in breaching the furnace will be prevented. Specific controls will be identified during final design and described in the ISA summary.

CONFINEMENT/VENTILATION

The MFFF confinement concept for sintering furnaces is similar to the one used in MOX facilities such as MELOX, CFCa-Cadarache and Belgonucleaire Dessel.

The three MELOX sintering furnaces (most similar to MFFF) have not released any contamination. Minimal maintenance is needed on furnace modules that are external to gloveboxes, as no moving parts are involved in the hotter zone. If maintenance is needed, the furnace is cooled and set under negative pressure.

Infrequent maintenance operations, such as a sintering module replacement, (1m length by 1.1 m in diameter) need adequate space for the handling of each module. Due to the module's size, it is not compatible for this module to be located in a glovebox. Moreover, a significant part of the cooling is performed through the natural convection in the room, which would be difficult to guarantee inside a glovebox.

Finally, even if a seal failure did occur, it would be expected to result in a small leak, an initial evaluation of the potential dose consequences to a facility worker indicate that it is highly unlikely that a worker will receive a dose exceeding the performance requirements of 10CFR70.61.

Enclosure A
Responses to NRC Clarification Requests

HUMAN FACTORS

Clarification Requested:

RAI 225: (1) Clarify its response by more explicitly defining what is meant by "significant human-system interface" for the protective control system. (2) DCS agreed to consider and evaluate the potential for personnel errors of commission that might result in overriding or defeating safety systems. (3) DCS also agreed to provide a cross-reference(s) to appropriate parts of Chapter 11 of the CAR {03 Nov 2001 item 7B}.

Response:

The personnel and equipment protective (PEP) control subsystem is non-PSSC. It is designed to satisfy industrial safety requirements (29 CFR 1910) and to protect the equipment. The protective control subsystem has no human-system interface (HSI) that allows an operator to bypass its functionality, therefore, an evaluation of errors of omission or commission is not warranted. The operators are not required to interface with nor be cognizant of the protective control system except to perform maintenance or to monitor its sensors or resultant actions. The operators have no direct access to the controllers and cannot routinely intervene in their operation. Monitoring of the PEP control system's sensors and actions is performed through the normal control system HSI.

The protective control systems are intended to prevent incidents, other than nuclear, with the potential to cause:

- long shutdown periods
- damage to equipment involving extensive repair
- injuries to operating or maintenance personnel.

The protective control subsystems consist of programmable logic controllers (PLC) or hardwired controls. When protecting operators, the protective control subsystem looks at the human-machine interference zones and interlocks the operation of the equipment when it detects an obstruction within the zone or the release of a dead-man switch. When protecting equipment, the protective control subsystem monitors the equipment for such conditions as overspeed, overtorque, overtravel, sensors at machine interface to avoid collisions, or other conditions as necessary.

The operation of the personnel and equipment protective controllers is described in CAR Section 11.6.3.3.2.

Enclosure A
Responses to NRC Clarification Requests

HUMAN FACTORS

Clarification Requested:

RAI 227: Clarify its response by more explicitly defining what is meant by "other deterministic design basis accident assumptions and scenarios," and also to consider and evaluate the potential for personnel errors of commission that might result in overriding or defeating safety systems {03 Nov 2001 item 7C}.

RAI 230: Clarify its response by including both human errors of omission and commission in their evaluation of the probability of human error {03 Nov 2001 item 7E}.

Response:

The design basis hazards are identified in section 5.4.1.1 of the CAR.

No scenario has been identified where omission of an operator action results in adverse conditions, and errors in operator actions have been anticipated in the system design while considering other deterministic design basis accident assumptions and scenarios. That is, in the analysis of design basis accident sequences, the initiating events internal to the facilities take into account the credible worker errors of commission if they are not a part of an enhanced administrative control used as IROFS. Such accident event sequences look at the operator actions that would normally be expected to occur given the type and amount of information received as a result of the event. Event sequences may be propagated as a result of a determination that the operator is likely to make an error of commission. Event sequences are stopped when the consequences of the actions are known and the event is not further propagated as a result of a consequence.

The possibility of overriding or defeating any of the safety functions due to a personnel error of commission is analyzed during the LA/ISA analyses.

The safety controller has direct control over its own actuators and devices so that its safety functions cannot be bypassed or circumvented by the normal control system. The operators are generally not required to initiate and cannot intervene in the action of the safety controllers. If the process requires human interaction, the related personnel actions (acts of commission) are covered by enhanced administrative procedures. In all these cases, the worker does not have to be cognizant of the safety control system in order for the safety controller to perform a safety function. The operator is informed of the status of the safety controller's actions by signals sent to the normal PLC.

In addition to the above dispositions, if a personnel error of commission could lead to a condition that exceeds 10 CFR 70.61 criteria, these personnel errors of commission are covered by enhanced administrative procedures and:

- suitable worker qualification and worker training,
- using checklists, two-party verification, placards and markings,

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- management of change during operations and maintenance (e.g., operating work sheet validation, maintenance preparation and validation, continuous validation of the safety responsibility chain),
- human-system interface design,
- Quality Assurance related to the administrative procedures for operations and maintenance,
- management staff and safety staff (and regulator) audits and inspections

The operation of the safety controllers is described in CAR Section 11.6.3.3.3.

Clarification Requested:

RAI 231, 233: Summarize significant events involving human performance as part of the review of operating experience at the MELOX and La Hague that were discussed at the meeting {03 Nov 2001 item 7F}.

Response:

1. Summary of significant improvements related to human error/lessons learned

As presented in the CAR chapter 12, the operational lessons learned from the references facilities were incorporated into the preliminary design of the process units. The following significant improvements are specially related to Human-System Interface.

<u>Process control system – Architecture principle</u>

- Improved in 1993 during the start-up: UF, GEPF, re-start cycle, … ;
  The facility is broken down into Functional Units (FU). A functional unit is a set of technological resources that fulfill a production function (manufacturing, …). Each FU has a dedicated monitor located in process workshop control room. Each FU is functionally made up of one or more mechanical sub-assemblies operated independently of each other. They are called 'Group Elementary Process Functions' GEPF. Each GEPF can be operated in a different mode; one GEPF can be in automatic mode and the other in manual maintenance mode.

<u>Process control system – Mechanism level</u>

- In order to improve the reliability and availability of the production system, the architecture trend was to simplify I&C (i.e. limitation of the number of sensors and actuators) according to the results from systematic methods.

<u>Process control system – Information treatment</u>

- The arrangement of control rooms and electronics equipment rooms with respect to the location of mechanical equipment was evaluated against the required tasks of the operators. The resultant design for MFFF integrates operations facilities and tasks into the layout of the

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process spaces. In addition, control rooms are distributed throughout the facility in close proximity to the processes controlled.

- The architecture using the separation of the different process in elementary actions driven by control cycles (algorithms) was unsuitable to the cartography control, the traceability control, to register quality or process parameters and to treat measures from the process. So the control system was improved at MELOX by means of the use of process computers for instance;
  In some units the use of process computers (PC) must be implemented. They are of two types:
  - Product quality control
  - Operating PC

  Their main functions are:
  - acquisition and processing of specific process measures;
  - archiving and editing of data and parameters;
  - processing of quality control and manufacturing control data;
  - transmission of data to the Normal Control System
  - synchronization with the unit PLC

  These functions are taken into account in the I&C design of MFFF.
- In order to perform a primary diagnostic when a production unit breaks down, MELOX implemented a Computer-Aided Diagnosis System. This system is also implemented in the I&C design of MFFF (see CAR 11.6.3.9).

<u>Utilities control system (ventilation and electricity) – Information treatment</u>

- The arrangement of the plant principal control room was evaluated for MFFF based on lessons learned, against the required tasks of the operators. Also, alternate redundant control locations for plant utilities and emergency systems are provided on MFFF.
- Improvement of the views on the workstation screen. These improved views are the basis of design, before detailed Americanization studies.
- Improvement of the organization and hierarchisation of the alarms in order to show, as a priority, the safety default.
- For MFFF, simplification of the normal PLCs: renunciation of the 155H architecture and the redundant architecture (for the Normal PLC);
  Normal controllers are used by the normal control system. Programmable Logic Controllers (PLC) with non-redundant architecture are being used (i.e. non-redundant input and non-redundant programs with output comparison). Each functional unit has one or more PLC. Also, on the MFFF design some safety function supported by a normal channel will be lead by a safety controller[1].

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[1] Note: For the facility control system (e.g. ventilation, electricity supply), "safety" is used on MELOX for the stand-by and back-up control system (e.g. safety Programmable Logic Controller, safety sensor). The safety IROFS functions are supported by the redundant emergency control system.

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- When a process parameter is required for a nuclear safety function (Note: in general, we try to choose different parameters for the normal and the safety controls[1]), the safety sensor is different from the operating sensor; these sensors are not redundant. However, the safety controllers[1] send a status of the safety sensor to the normal controller to check that it is consistent.

2. Summary of a significant event involving human error

2.1. Event description

This event occurred on August 6, 1997. It was classified level 1 on the International Nuclear Event Scale (INES) rating, due to the stop of the VHD exhaust.

This event had no consequence on worker and no impact on the environment.

The event sequences could be summarized as follow:

- Human error during programmed maintenance on a ventilation system electrical sensors cabinet,
- Loss of the 24 V supply of the information (ventilation sensors) separator cabinet. This cabinet was used to share the information of the safety sensors with the normal PLC.
- Partial loss of the information on the screens on the Normal and the Safety PLCs.
- Stop of the VHD fans.
- Difficulty to restart in local one VDH fan.

2.2. Lessons learned taken into account in the preliminary design

The improvements made on MELOX, which are taken into account in the MFFF bases of design, are:

- MFFF will have four (4) VHD systems (vs. 3 on MELOX)
- To improve the process of analyzing the performance of programmed maintenance activities (DCS is aware of the importance of this process regarding the operator commission error).
- To completely separate the safety information from the normal information. The information from the safety sensors is sent directly from the safety PLC to the normal PLC (with electrical isolation device).
- To separate and provide redundant power supplies for safety sensors and actuators (to be evaluated during the detail design of MFFF).
- To add a manual hard wired start command of each VHD fans in the principal control room actuators (to be evaluated during the detail design of MFFF).

INSTRUMENTATION AND CONTROLS

Clarification Requested:

RAI 66: DCS will provide clarification that criticality prevention related to material inventory control is the only safety function that has been allocated to software. A list will be provided if there is more than one safety function allocated to software {03 Nov 2001 item 9, 3rd paragraph}

Response:

At the time of the CAR, the inventory control safety functions were the only safety functions allocated to software control. As the designs were further analyzed, a number of non-inventory safety functions have been identified. Depending on the complexity of these functions, DCS may decide to allocate these safety functions to software control. This work is currently in progress and no decisions have been made at this time. DCS has developed an initial list of sensors that have been designated as IROFS and the safety function associated with the sensor. This list is available for onsite review by NRC staff. The design basis for any PSSCs that include software is described in CAR 11.6.7.

Clarification Requested:

A list of functional units showing non-PSSCs PLCs and PSSCs PLCs will be submitted {18 Dec 2001 item B2}.

Response:

The list of functional units showing non-PSSCs and PSSCs is provided in Table 1. This list is based on evolving detailed design drawings and is subject to change as work on final detailed design progresses.

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TABLE 1: PRELIMINARY LIST OF FUNCTIONAL UNITS AND THEIR PLC'S

Functional Unit	Unit ID	Number of PLCs	
		Non-PSSC	PSSC
SHIPPING AND RECEIVING POWDERS			
U02 Drum Receiving/Storage/Emptying	DDP/DRS	1	0
PU02 Receiving and Storage Unit	DCP/DCM	1	0
PU02 Buffer Storage/Pneumatic Transfer for powder	DCE/NTP	1	0
Subtotal		**3**	**0**
POWDERS			
Sample Pneumatic Transfer	LTP	1	0
Jar Storage Handling	NTM	1	0
3 PU02 Can Receiving and Emptying	NDD	1	0
Primary Dosing	NDP	1	1
Ball Milling No. 1	NBX	1	0
Ball Milling No. 2	NBY	1	0
Scrap Processing	NCR	1	0
Final Dosing	NDS	1	1
Auxiliary Powder	NXR	1	0
Homogenizing & Pelletizing No. 1	NPE	1	0
Homogenizing & Pelletizing No. 2	NPF	1	0
Subtotal		**11**	**2**
PELLETS			
#1 Sintering Furnace/Gas treatment/cooling/heating	PFE 1	1	0
#1 Furnace Entry/Exit/Conveyer/inspection/boat thruster	PFE 2	1	0
#2 Sintering Furnace/Gas treatment/cooling/heating	PFF 1	1	0
#2 Furnace Entry/Exit/Conveyer/inspection/boat thruster	PFF 2	1	0
#1 Pellet Grinding	PRE	1	0
#2 Pellet Grinding	PRF	1	0
#1 Basket Entry – Tray Loading	PTE 1	1	0
#1 Pellet Inspection and Sorting	PTE 2	1	0
#2 Basket Entry – Tray Loading	PTF 1	1	0
#2 Pellet Inspection and Sorting	PTF 2	1	0
Quality Control Manual Sorting	PQE	1	0
Pellet Repackaging	PAD	1	0
Scrap Box Loading	PAR	1	0
Handling and Green Pellet Storage	PSE	1	0
Handling and sintered Storage	PSF	1	0
Handling and Scrap Storage	PSI	1	0
Handling and Ground/Sorted Pellet Storage	PSJ	1	0
Subtotal		**17**	**0**
CLADDING – ROD INSPECTION			
Inspection/Repair/Welding/Seal Welding/Decontamination/Rod Handling	GME 1	1	0
Rod Filling	GME 2	1	0
TWLP Entry/ TWLP Rod Handling/ Seal and Circular Welding	GMF 1	1	0
Basket Entry/Length Adjustment/Rod Filling/Cleaning/Plug Inspection/Decontamination	GMF 2	1	0
Rod De-cladding	GDE	1	0

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Functional Unit	Unit ID	Number of PLCs	
		Non-PSSC	PSSC
Rod Tray Loading	GMK	1	0
X-Ray Test	SXE	1	0
Helium Leak Test	SEK	1	0
Rod Inspection and Sorting	SDK	1	0
Rod Scanning Test	SCE	1	0
Handling and Rod Storage	SMK	1	0
Subtotal		**11**	**0**
ASSEMBLY - WASTE			
Assembly Mockup Loading	TGM	1	0
Assembly Fabrication	TGV	1	0
Hoist/Shielding Doors/Crane	TAS	1	0
Assembly Dry Cleaning	TCK	1	0
Assembly Dimensional Inspection	TCP	1	0
Assembly Final Inspection	TCL	1	0
Assembly Final Inspection	TXE	1	0
Waste Storage	VDQ	1	0
Handling Crane/Fire detection	VDT	2	0
Filter Dismantling/Mechanical Dismantling	VDR/VDU	1	0
Waste Compaction	VDC	1	0
Subtotal		**12**	**0**
Aqueous Polishing System			
De-canning Air locks/inner-outer can opening/pneumatic transfer	KDA	3	2
Dissolution	KDB	1	0
Purification	KPA	2	0
Solvent Recovery	KPB	1	0
Acid Recovery	KPC	1	0
Oxalic Mother Liquors recovery	KCD	1	0
Oxalic Precipitation/ Oxidation	KCA	1	0
Homogenization	KCB	1	1
Canning	KCC	1	1
Off Gas Treatment	KWG	1	0
Liquid Waste Treatment	KWD	1	0
Silver Recovery	KPF	1	0
Sampling processes	KPG	2	0
Subtotal		**17**	**4**
Utility Systems			
Reagents	KRA	2	0
Steam, Hot Water, Cooling Water, Demineralized Water	KUA/KUB/ KUD/KUG/ KUH	1	0
Fluids/Effluents	-	4	0
HVAC	-	5	0
Electrical distribution	-	3	0
Subtotal		**15**	**0**

INSTRUMENTATION AND CONTROLS

Clarification Requested:

Identify the requirements for the fire detection system interface with the PSSC safety controller VDT {18 Dec 2001 item B6}.

Response:

Any fire detection system signals or electrical interface with other systems must do so in accordance with the requirements of NFPA 72. The VDT fire safety controller is not a PSSC and is classified as a quality level 1b device and is not credited in the safety analysis. As such, it has been graded out of compliance with IEEE 603. The details of the fire safety system will be provided as part of the license application.

Clarification Requested:

RAI 151: DCS staff will further describe the basis for not classifying the communications system as an IROFS {18 Dec 2001 item B7}.

Response:

The communications system is not classified as an IROF because there are no design basis events that require the communications system to perform a safety function.

SAFETY ANALYSIS AND CHEMICAL SAFETY

Clarification Requested:

Calculations for three load drop type events were requested by NRC because it was not clear that the development of the accident left sufficient time for worker protective action {06 Nov 2001 item 2}.

Calculations for facility worker dose from the fuel rod/fuel bundle drop event, the waste container drop event, and breach of container outside gloveboxes (confinement event). Alternatives to calculations may be proposed by DCS {06 Nov 2001 item 2E}.

Response:

As requested by the NRC, DCS is performing additional evaluations of the potential dose consequences to a facility worker associated with selected events. During these ongoing analyses, DCS has evaluated several scenarios involving the following events; a waste drum drop event in the waste drum storage area, an assembly drop in the assembly storage and shipping area, a transfer container drop during transfer, and a furnace seal leak in the MP furnace room. Initial conclusions of the evaluation indicate that it is highly unlikely that a worker will receive a dose exceeding the performance requirements of 10CFR70.61. For event sequences where consequence analysis is utilized to form the basis of this conclusion, workers are assumed to be in the impacted area for at least 30 seconds and do not use their personnel protection equipment.

Clarification Requested:

Review of the pyrophoric nature of plutonium and uranium oxides; clarification or justification of adequate control of potential hazards from UO_2 and PuO_2 {18 Dec 2001 item A1}.

Response:

Pyrophoricity of UO_2 and PuO_2 is not a concern in the MFFF since both uranium and plutonium powder are maintained in a dioxide form during processing in the MOX processing area. Although plutonium metal and several plutonium compounds are pyrophoric, PuO_2 is stable and unreactive in air.[2] The characteristics of uranium are similar to those of plutonium and is not considered pyrophoric. Correct material receipt is verified prior to use of the material in MFFF processes.

Although UO_2 is stable, it can undergo spontaneous oxidation in air during heating when it is in the form of a finely divided powder. This chemical reaction is typically called "burnback". The products of this oxidation reaction are higher oxides of uranium, including the most stable form,

[2] DOE-HDBK-1081-94, "DOE Handbook: Primer on Spontaneous Heating and Pyrophoricity", US DOE, December 1994, pg. 33.

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U_3O_8[3]. The consequences of burnback, in addition to the impurities added to the bulk PuO_2 powder, include heat addition to the surrounding air or material. At the MFFF, the UO_2 is processed as a fine powder at low temperatures and within inert atmospheres, thus burnback does not occur during normal operations. Burnback could occur during offnormal conditions if the inert atmosphere has been replaced by air. The burnback of UO_2 to U_3O_8 has been taken into consideration in the thermal analyses of the MFFF during these offnormal conditions. See the response to CAR RAI#49 for additional information related to the burnback of UO_2. Burnback of PuO_2 does not occur because it is the most thermodynamically stable oxide state.

Clarification Requested:

RAI 57: Basis (*i.e.*, correspondence from DOE) for explosion potential in F area {18 Dec 2001 item A2}.

Response:

Tank sizes, location, and contents for the CAR hazard screening were obtained by reviewing a number of documents, provided by DOE. The references utilized for the CAR hazard screening are available for onsite review. Calculations in support of the ISA are currently being developed based on updated values and references. The preliminary results of the calculation have not identified any changes in the design basis information provided in the CAR. The references and calculations, when completed, will be available for onsite review by NRC staff.

Clarification Requested:

Provide an analysis of the potential for steam explosion in the MFFF {18 Dec 2001 item A3}.

Response:

Steam explosions within the sintering furnace have been identified during the MFFF safety analysis as a credible event. The safety strategy proposed in the CAR is to prevent explosions that involve radioactive material within the MFFF primary processes. Although steam explosions were not explicitly identified in the CAR as a specific cause of an explosion in the sintering furnace, an explosion in the sintering furnace was identified in the CAR and described in event PT-4. As described in the CAR methodology, no attempt was made to identify all causes of events in the PHA for prevented events such as a furnace explosion. However, all causes of the event will be identified and evaluated during the detailed analysis performed to support the ISA.

Process safety hazards analysis currently being prepared for the ISA have identified three types of scenarios that have the potential to lead to a steam explosion in the sintering furnace or it's

[3] Y/ES-014/R4, "Assessment of Enriched Uranium Storage Safety Issues at the Oak Ridge Y-12 Plant", US DOE, Uranium Storage Assessment Team - Oak Ridge Y-12 Plant, August 1996, pgs. 15-16.

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interconnected support systems. These event types are discussed below along with a discussion of the associated controls.

1) Direct entry of cooling water to the furnace from the cooling loop.

Water cooling to the furnace travels through external cooling coils wrapped around the furnace welded stainless steel outer shell. Water entry into the furnace from the cooling loop is prevented by two barriers; the boundary of the cooling coils, and the furnace shell. This event sequence involving the simultaneous leak in the cooling coil and a leak in the furnace shell will be demonstrated to be highly unlikely.

Although a steam explosion involving a water cooled furnace has previously occurred at LANL, the furnace involved was cooled by an internal cooling loop. Thus, a leak in the cooling loop resulted in water being released directly inside the hot furnace. As previously described, the sintering furnace used at the MFFF is cooled by an external loop. Thus, a leak in the cooling loop will not result in water entering the furnace.

2) Direct Entry of Humidifying Water into furnace

The argon hydrogen mixture entering the furnace is humidified by passing the gas mixture through a bubbler before entering the furnace. Overfill of the bubbler could lead to excessive water intake into the sintering furnace and excessive steam generation. IROFS are currently being identified to ensure that the water level within the bubbler is maintained within a safe range. Specific IROFS features such as a passive hydraulic device or level controllers will be incorporated into the design to meet the single failure criteria to ensure that this scenario for a steam explosion is highly unlikely.

3) Steam generation within the cooling water systems

Loss of secondary cooling or loss of cooling flow within the primary loop can lead to heat-up and steam generation within the cooling loops. Even though the furnace heating power will be automatically shutdown by hard wired logic (on loss of cooling water flow, high furnace internal temperature, or high furnace shell temperature), the furnace is still hot and may generate steam within the cooling coils. Relief valves are provided on the cooling loops to prevent rapid overpressurzation of system piping due to the steam generation. Thus, a steam explosion in the cooling coils is highly unlikely. Note that upon loss of cooling shutoff of the furnace heating power, the furnace will cooldown by natural convection without any safety implications associated with the furnace itself as the seals are designed to maintain their functions in these temperature conditions.

In addition, the CAR identified explosions in the laboratory as a potential event. Steam explosions involving a small laboratory size furnace will be prevented as necessary. Specific features to accomplish this will be identified in the ISA. The ISA will also demonstrate that any potential explosion in the laboratory will not impact the MFFF processes.

SAFETY ANALYSIS AND CHEMICAL SAFETY

Clarification Requested:

Clarification/explanation of sintering furnace sensors, controls, and PSSCs related to hydrogen explosions {18 Dec 2001 item C1}.

Response:

Description of Ar/H2 controls related to the sintering furnace:

SAFETY ANALYSIS AND CHEMICAL SAFETY

SAFETY ANALYSIS AND CHEMICAL SAFETY

Clarification Requested:

RAI 143: Update the response to the RAI to include analytical results showing low consequences from low-level radioactive waste and spent solvent streams, and identification of upstream PSSCs {18 Dec 2001 item CC2*}.

Response:

The analysis performed for the CAR evaluated MFFF waste streams including the low level radioactive waste and spent solvent streams described in the response to RAI 143. Due to low radioactive material content of these waste streams, events involving these waste streams are bounded by other waste related events. The unmitigated consequences of events involving these waste streams is low as defined by 10CFR70.61. Thus, no principal SSCs are required to prevent or mitigate events involving these waste streams.

SAFETY ANALYSIS AND CHEMICAL SAFETY

Clarification Requested:

RAI 122: Respond to NRC concerns about the approach for inerting hydrazine and solvent {18 Dec 2001 item CC4*}.

Response:

The purpose of nitrogen blanketing on aqueous hydrazine is to exclude oxygen that may react with the hydrazine under storage conditions, thereby decreasing the effectiveness of the hydrazine. The concentration of aqueous hydrazine as supplied and used in the reagent building (BRP) is 35% and does not have a flash or fire point at this concentration per ASTM Method D92 (COC) as found in Table 2 below.

The blanketing is not used to prevent fire or explosion. The 35% hydrazine solution is only used in the reagents building BRP; however, a dilute 0.14 M solution with 0.15 M hydroxylamine nitrate in 0.1 N HNO_3 is used in the BAP and it is also blanketed. HAN has no flash point and is considered not flammable. Continuous purging is therefore not required.

Table 2: Physical Properties of Aqueous Hydrazine Solutions (Ref: www.hydrazine.com)[c]

	Weight % N_2H_4					
	35%	35%	35%	51.2%	54.4%	64%
Property	Scan-Ox[b]	Scan-Ox Plus	Scan-Ox II			
Density @ 25°C (g/ml).(lb/gal)	1.02 (8.52)	1.01 (8.504)	1.02 (8.51)	1.028 (8.58)	1.031 (8.59)	1.032 (8.61)
Viscosity @ 25°C (cp)	1.02	1.40	-	1.44	.45	1.5
Boiling Point @ 760 mm Hg(°C)	109.4	109.5	109.4	119.0	119.8	120.1
Freezing Point (°C)	-65	-65	-65	-57	-57	-51
Flash Point, COC[a] (°C)	**None**	None	None	93	89	72
Fire Point, COC[a] (°C)	**None**	None	None	102	96	74
Heat of Formation, Liq. (kcal/mole)	-	-	-	-	8.140	10.300
Specific Heat @ 130°F(Btu/lb/°F)	-	-	-	-	-	.0838
@ 54°C(cal/g/°C)	-	-	-	-	-	.0838
Solubility in Water	Completely miscible	Completely miscible	Completely miscible	Completely miscible	Completely miscible	Completely miscible
Vapor Pressure @ 25°C(mm Hg)	22	22	22	2-5	2-5	2-5

a Cleveland Open Cup (ASTM Method D92)

b Scan-Ox contains no catalyst

c Data from Arch Chemical (successor to Olin Corporation Specialty Chemicals)

SAFETY ANALYSIS AND CHEMICAL SAFETY

Equipment and piping used at MFFF for handling hydrazine will be Type 304L stainless steel based on data as shown in Table 3 below.

Table 3: Compatibility of Materials with Hydrazine Solutions (Ref: www.hydrazine.com)[d]

	HYDRAZINE CONCENTRATION IN AQUEOUS SOLUTION				
Material	< 10%	35%[a]	51.2%	54.5%	64%
Stainless Steels					
304L	S	S	S	S	S
347	S	S	S	S	S
316	S[b]	S[b]	S[b]	S[b]	S[b]
Cold Rolled Steel	S	NR	NR	NR	NR
Copper	NS	NS	NS	NS	NS
Brass	NS	NS	NS	NS	NS
Teflon[c]	S	S	S	S	S
Polyethylene	S	S	S	S	S
Aluminum	NS	NS	NS	NS	NS

a Scav-Ox®, Scav-Ox® II and Scav-Ox® Plus are 35% solutions.
b Up to 150°F
c Trademark of E.I. dupont de Nemours, Inc.
d. Data from Arch Chemical (successor to Olin Corporation Specialty Chemicals)
S Generally Satisfactory.
NS Not suitable (due either to decomposition of the Hydrazine or to adverse effects of the solution on the materials of construction).
NR Not recommended.

Solvent is a 30% mixture of TBP in dodecane that is used for extraction in the purification (KPA) step of aqueous polishing. TBP is the active component in the Solvent with the dodecane serving only as a diluent carrier.

Solvent and its components are vented to the outside atmosphere in accordance with NFPA 30 requirements for NFPA Class II (dodecane) and NFPA Class IIIB* (TBP) materials within storage tank buildings, such as the BRP. In the BRP, the vents are direct to the outside; however, for the BAP, the vents are sent to the Off-Gas Treatment System that then discharges to the outside atmosphere through the main stack. Fire protection systems are provided in the BRP and BAP to meet the intent of NFPA 30. Further, the vents are sized to prevent pressure build-up inside the vessels. The Solvent and its components are used only in all-welded and grounded vessels and piping, eliminating ignition sources during storage and use.

According to the technical data in the MSDS (Mallinckrodt Baker MSDS T4706/CAS Ref 126-73-8), tributylphosphate (TBP) has a flash point of > 120° C (250° F), well above the operating conditions to be found in both the BRP and BAP.

SAFETY ANALYSIS AND CHEMICAL SAFETY

Dodecane (CPChem MSDS 707430/CAS Ref. 68551-17-7) is a stable C-12 petroleum fractional "cut" and consists of a range of aliphatic hydrocarbons from C-10 to C-13. The vapor pressure is 1.5 mm Hg at 100° F (38° C) and the flash point is > 135° F (> 57° C).

Discussions with Cogema's La Hague (France) plant indicate that the flash point increases to more than 150° F (> 66° C) when the solvent mixture is exposed to water as it is during the aqueous/organic extraction/purification step (KPA) in MFFF.

Based on this information, blanket or purging is not required for the solvent or its components in storage and in use.

* Because TBP is a Class IIIB combustible liquid and Section 2-5 of NFPA 30-1996 states in part that tanks "storing Class IIIB liquids shall not be required to the provisions of this section," it is not necessary for TBP vessels to be in this configuration.

Clarification Requested:

RAI 204: Estimate the number of high pressure cylinders in the facility and the annual usage {18 Dec 2001 item CC9*}.

Response:

Tables 4 and 5 provide the estimates for high pressure cylinders and annual usage for MFFF. These estimates are based on data obtained from Cogema facilities in France.

Table removed under 10 CFR 2.390.

Table removed under 10 CFR 2.390.

FIRE PROTECTION

Table 5 MFFF Fire Features Summary

Clarification Requested:

Provide additional info about process cell fire prevention features {verbal information request}.

Response:

Process cell fire prevention features are used to ensure that fires in the process cells are highly unlikely. This is accomplished through the control of ignition sources within the process cells.

Associated with the AP process, ignition sources may arise due to electrical equipment, static electricity, and as a result of some chemical reactions. The presence of these three sources of ignition sources within the AP Process Cells are prevented through the following features:

1. No use of electrical equipment within the process cells
2. Grounding of equipment within process cells
3. The use of controls to ensure that potential chemical reactions that may result in a fire are made highly unlikely.

During normal operations, process cell design precludes the entry of personnel which could introduce ignition sources. Provisions exist in the design for removal of process material in the event of entry of personnel into process cells (*e.g.*, for maintenance), and additional administrative controls (such as fire watch, etc.) will be applied as necessary.

Finally, fire barriers are designed to limit the effect of fires such that a fire external to the process cells will not affect the process cells.

Clarification Requested:

NRC staff requested that DCS provide a summary table/spreadsheet from the FHA; DCS will consider providing this table/spreadsheet with fire area information such as principal SSCs/IROFS, additional protective features, and fire barrier rating {06 Nov 2001 item 3}.

Response:

The attached Table 6 provides a summary of the fire areas, fire barrier ratings, automatic suppression systems, and IROFS located within fire areas. This table summarizes information from the fire hazards analysis (FHA) which is currently being developed and based on current design information which is evolving. Therefore, the summary information is subject to change, however, the information is consistent with the draft of the FHA reviewed by NRC during the onsite visit 24 January 2001. The complete list of IROFS will be developed as part of the ISA.

Table removed under 10 CFR 2.390.

Enclosure B
Remaining NRC Clarification Requests

The following table summarizes the status of the open clarification requests noted within the 03 and 06 November 2001 and 18 December 2001 NRC In-Office Review Summaries and verbal information requests received by DCS.

Subject Area/Action Item	**Source**
Heavy Loads/Material Handling	
RAI 221: Clarify the editions of the Codes and Standards that will be used to design heavy lift cranes.	03 Nov 2001 item 2E
Confinement/Ventilation	
NRC recommends the use of a 99 percent removal efficiency in both fuel cycle facility and reactor applications. NRC staff explained there have been fires at plutonium facilities that have resulted in failures of banks of HEPA filters and that the recommended removal efficiency of 99 percent reflected such experience. DCS proposed to consider another calculation that would better define the accident conditions affecting the HEPA filters.	03 Nov 2001 item 4
Is the ventilation stack considered to be a PSSC? Have analyses for seismic and natural phenomena been performed? Discuss design basis for stack.	Verbal information request
Instrumentation & Controls	
The staff pointed out that IEEE 603-1998 conformance may be difficult for the following reasons: A. The MMIS computer system and the data communications network would have to meet IEEE 603-1998 criteria; and B. The subset of the MMIS software that would be used for IEEE 603 credit would have to be qualified. After discussion of the dimensions of the difficulties, DCS stated that it would take the observations under advisement and inform the staff whether it intends to revise its design basis for the MMIS system.	06 Nov 2001 item 4, 3rd paragraph
DCS staff will clarify Section 11.6.2.1 (last paragraph) of the application to describe those cases where a safety control subsystem is used as a PSSC (the case which invokes IEEE Std 603-1998).	18 Dec 2001 item B3
DCS staff will review other sections in the application, such as Section 11.6.7, Table 5.6-1, and Section 5.5.5.2, to ensure the correct design basis information is included for safety control subsystems.	18 Dec 2001 item B4
When the AP or MP control room(s) is shutdown, does that mean that all functions performed in that room are also shutdown (i.e., fire detection system is shutdown when the control room is down)? Need to clarify the text in the CAR.	Verbal information request
Safety Analysis/Chemical Safety	
As a result of the review of safety analysis documents, NRC staff questioned the terminology "Process Safety I&C Systems" to determine the actual systems were being listed as SSCs. DCS will provide the information.	06 Nov 2001 item 2, 5th paragraph
For each listing of "Process Safety I&C systems" in the Principal SSC summary tables of Section 5.5 of the CAR, DCS will replace with "Process Safety Control Subsystem" or "Emergency Control System".	06 Nov 2001 item 2D
DCS agreed to clarify the nomenclature so that the nomenclature is consistent between the chapters of the CAR. In doing so, DCS will revise the Chapter 5 tables so that for a particular event, the principal SSCs for I&C systems will be clearly identified.	06 Nov 2001 item 4, 2nd paragraph
Verify that pressure sensors will detect a hydrogen leak in the sintering furnace and will terminate hydrogen flow.	18 Dec 2001 item CC5*

* Note on usage: Section C of the 18 Dec 2001 letter contains two action item lists, both beginning with "item 1"; the first list is herein designated beginning with "C1" and the second beginning with "CC1" for clarity. Also, certain items in the second list are repeated; the redundant actions (CC6-8) are excluded in this listing.

Enclosure B
Remaining NRC Clarification Requests

Explanation of the applicant's interpretation of the red oil phenomena and justification for a temperature design basis of 135 C (RAI 123). RAI 123: Provide information to support and justify the 135 C limit as the only design basis for the evaporators.	18 Dec 2001 item C2* and CC3*
Verify the accident scenario labeled "fire" in AP/MP C3 glovebox area is the same used for bounding mitigated fire/loss of confinement consequence assessment - appears to be some minor differences.	Verbal information request
Multiple possible explosion sources assumed for bounding mitigated explosion? (Not clear whether this means multiple simultaneous sources or sources in different locations at different times).	Verbal information request
The draft FHA in preparation by DCS indicates that the nitrogen system is relied upon for 70.61 compliance. DCS to clarify position on nitrogen system.	Verbal information request
In CAR Chapter 10, DCS stated an ALARA goal for effluent releases to limit dose to the public and limit the concentration in the air. If the concentrations provided in the Environmental Report (Table D7 or B7) are applied at the discharge of the stack, it appears to exceed the ALARA goal. Provide an updated list of radionuclides or other assumptions such that demonstrates the ALARA goal is achieved.	Verbal information request
As part of the Environmental Consequences calculation, ensure that information is provided at the restricted area boundary, identify the HEPA filter efficiency used, and that a respirable fraction is not included.	Verbal information request
Electrical	
RAI 162: In the DCS clarification letter of 07 January 2002, p. 23, DCS cites section 5.2 of IEEE-484 and the practice of using acid resistant insulation between cells and steel of the racks. NRC Regulatory Guide 1.128 also indicates that the insulation is moisture resistant. What is DCS position on moisture resistant insulation for this application?	Verbal information request
RAI 162: In the DCS clarification letter of 07 January 2002, p. 23, item 6. The NRC position notes that the "should" in the IEEE standard are to be treated as "shall." Discuss how DCS intends to apply this guidance in RG 1.128, item 6 with respect to IEEE 484.	Verbal information request
RAI 162: In the DCS clarification letter of 07 January 2002, p. 23, item 2, the response did not address Regulatory Guide 1.189 information on battery room fire protection that superseded Regulatory Guide 1.120	Verbal information request
Criticality	
RAI 40/41: NRC provided DCS with additional information on highly unlikely and double contingency. DCS to provide discussion of position.	03 Nov 2001 item 3E
RAI 68: NRC provided additional information to DCS on the Qualifications of a Criticality team. DCS to provide an updated response to minimum qualifications.	03 Nov 2001 item 3F
RAI 83: DCS provided an clarification by letter dated 07 January 2002, however, the NRC was expecting more discrete values.	Verbal information request
RAI 90: NRC has reviewed the DCS response in the letter of 31 August 2001 and the clarification provided by letter dated 05 December 2001 and has additional questions. First, for the discussion of ANSI 8.1, define what is meant by "or other justifications" and define "not expected in the life time of the facility" - is this the same as 1E-2 or is it something different since the life of the facility is not 100 years? In the discussion for ANSI 8.15, DCS uses the term "very low" and states that ANSI 8.1 will be used for special actinides. Define "very low" and at what point does DCS expect quantities to be low enough that the use of ANSI 8.1 is applicable. Finally, define the use of "or other justifications" in the discussion of ANSI 8.17.	Verbal information request

Enclosure B
Remaining NRC Clarification Requests

Mechanical	
Address corrosion allowances in process cells vs ability to perform inspections.	Verbal information request
For the manual isolation valve discussion in CAR Section 11.4.7.1.5, clarify if these are the only type of isolation valves on gloveboxes (for mechanical systems).	Verbal information request
NRC understands that DCS is considering changes to fresh fuel storage in shipping bay, possibly in frame storage. If so, what is design bases for the frames holding shipping casks? Will casks contain fresh fuel, i.e., used as buffer storage?	Verbal information request
In the 05 December 2001 letter, DCS provided a clarification to RAI 217 on fresh fuel cask lift heights. The response is not clear whether the height is applicable when lifting off a truck, i.e., what is max lift height to truck bay floor?	Verbal information request
Material maintenance and surveillance – clarify/address if the corrosive effects of dissimilar metals will be considered (e.g., bolting, galvanic processes). Need more discussion of corrosion effects on wet process systems.	Verbal information request
With respect to welded construction for fluid transport systems – are welding and welding procedures, qualifications, etc considered IROFS? If so, what are the specific codes and standards and criteria?	Verbal information request
In the CAR discussion of interfaces for decontamination systems, the text doesn't mention interface with demineralized water and nitric acid systems.	Verbal information request
Clarify why scavenging air is classified as IROFS. Identify where the instrument air system transitions from non-PSSC to PSSC – a diagram would be useful.	Verbal information request
Clarify status of N2 system as non-PSSC or PSSC (FHA implies PSSC, but informal discussions with DCS have indicated non-PSSC).	Verbal information request
RAI 201/CAR 11.9.1.9: The discussions of the instrument air system references ISA standard ISA S7.0.01-1996 and Service Air references ISA 7.3. Which one is DCS using and the issue date if ISA 7.3 is used?	Verbal information request
Clarify why the design bases for instrument air includes a HEPA for penetrations through confinement (CAR 11.9.1.10.2) but the bulk gas systems do not specify HEPAs (CAR 11.9.2).	Verbal information request
Provide glovebox design basis for structural analysis (discussed in polycarbonate report telecon).	Verbal information request
Clarify basis for not including seismic isolation and isolation valves in design basis for hydrazine system.	Verbal information request
CAR pgs 8-8, 8-27, 8-28 discusses P10 gas (methane and argon 7%). P10 gas is a different mixture than that specified (mixture reversed). Need clarification – provide any and all design bases for P10 system, including use, storage locations, and application and hazards. Other tables on smothering gases did not include P10.	Verbal information request
CAR pg 11.9-48 - What is the operating temperature for N2O4 (CAR 11.9.3.13.2 states 50 C). The RAI response (RAI 117?) provides a different temperature (30 C). If RAI is correct, how will temperature be maintained?	Verbal information request
CAR pgs 11.9-48 and Figure 11.9-29 identify service air interface with N2O4 system. Drawing GNO-RMN-14735 shows an instrument air interface. Which is correct?	Verbal information request
RAI 191 response discusses check valves design criteria. Need similar information for isolation valves.	Verbal information request
Site Description	

Enclosure B

Remaining NRC Clarification Requests

Section 1.3, Site Description – Does DCS plan to update the site description information – need statement from DCS that any new information at the time of license application will be included and provided to NRC.	Verbal information request
In section on site hydrology, CAR 1.3.4.6, there is a statement that no radiation was detected in Upper Three Runs and Gordon aquifers. Clarify if this means no detectable radiation or no radiation above EPA limits for drinking water.	Verbal information request
NRC and DCS staff to decide how to release information from seismic calculation justifying unlikely events.	30 January 2002 letter
Are any more studies of seepage basin plume for the state RCRA permits planned? Will DCS provide any updated study information on direction and flow of plume in aquifers? Information in the CAR seems generic and new studies might provide additional information.	Verbal information request
Financial	
Information on the project design costs is necessary. The RAI response for CAR chapter 2 stated that the information was under review by DOE. What is the status and when does DCS plan to submit new information?	Verbal information request
Does the design cost information include licensing costs? Are escalating and contingency costs included in design costs (they appear to be included in construction costs)?	Verbal information request
NRC understands Duke is undergoing reorganization. NRC needs the appropriate CAR sections updated to reflect financial and organizational changes.	Verbal information request