NRC FORM 464 Part I
(12-2015)

U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) REQUEST

FOIA	RESPONSE NUMBER
2016-0265	1

RESPONSE TYPE: ☐ INTERIM ☑ FINAL

REQUESTER: Edward M Burns

DATE: 03/22/2016

DESCRIPTION OF REQUESTED RECORDS:

seeks access to SECY-83-047, Development of Principal Design Criteria for CRBRP (Feb. 1, 1983) ADAMS ACC #8302090514 (microform 66612:307-360)

PART I. -- INFORMATION RELEASED

☐ Agency records subject to the request are already available in public ADAMS or on microfiche in the NRC Public Document Room.

☑ Agency records subject to the request are enclosed.

☐ Records subject to the request that contain information originated by or of interest to another Federal agency have been referred to that agency (see comments section) for a disclosure determination and direct response to you.

☐ We are continuing to process your request.

☐ See Comments.

PART I.A -- FEES

AMOUNT* $ 0.00

*See Comments for details

☐ You will be billed by NRC for the amount listed.

☑ None. Minimum fee threshold not met.

☐ You will receive a refund for the amount listed.

☐ Fees waived.

PART I.B -- INFORMATION NOT LOCATED OR WITHHELD FROM DISCLOSURE

☐ We did not locate any agency records responsive to your request. *Note*: Agencies may treat three discrete categories of law enforcement and national security records as not subject to the FOIA ("exclusions"). 5 U.S.C. 552(c). This is a standard notification given to all requesters; it should not be taken to mean that any excluded records do, or do not, exist.

☐ We have withheld certain information pursuant to the FOIA exemptions described, and for the reasons stated, in Part II.

☐ Because this is an interim response to your request, you may not appeal at this time. We will notify you of your right to appeal any of the responses we have issued in response to your request when we issue our final determination.

☐ You may appeal this final determination within 30 calendar days of the date of this response by sending a letter or email to the FOIA Officer, at U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or FOIA.Resource@nrc.gov. Please be sure to include on your letter or email that it is a "FOIA Appeal."

PART I.C COMMENTS (Use attached Comments continuation page if required)

The incoming request can be located in ADAMS at ML16032A026.

This document will be added to public ADAMS.

SIGNATURE - FREEDOM OF INFORMATION ACT OFFICER

Roger Andoh

DCS

February 1, 1983

POLICY ISSUE
(Information)

SECY-83-47

FOR: The Commissioners

FROM: William J. Dircks, Executive Director for Operations

SUBJECT: DEVELOPMENT OF PRINCIPAL DESIGN CRITERIA FOR CRBRP

PURPOSE: Information For The Commission

DISCUSSION: In December 1981 when we briefed the Commission on the resumption of the effort to license the Clinch River Breeder Reactor Plant (CRBRP), the matter of acceptance criteria arose. This paper reports on the development of Principal Design Criteria (PDC) for CRBRP.

The PDC are an important component in the safety review of a construction permit application. They represent the link between the General Design Criteria (GDC) of Appendix A to Part 50 and the specific criteria used to judge the acceptability of the CRBRP design. The enclosure, which is a final draft section of the forthcoming staff SER, presents the CRBRP PDC and describes how they have been developed and to what use they are put in the safety review.

We have discussed the CRBRP PDC extensively with the ACRS at two subcommittee meetings (30, 31 Mar 82 and 27 Oct 82) and at a full committee meeting (4 Nov 82). We expect that any ACRS comments on the PDC will be included in their letter on CRBR, currently scheduled for issuance by April, 1983. Also, we have had the benefit of review and comments by the principal formulator of the GDC and by the relevant technical review elements of NRR.

William J. Dircks
Executive Director for Operations

Enclosure:
As stated

Contact: J. Nelson Grace, CRBRPO:NRR
x-29737

ENCLOSURE

FINAL DRAFT SECTION 3.1

CRBRP SAFETY EVALUATION REPORT

3.1 Conformance With General Design Criteria

The purpose of this SER section is to present the final CRBR Principal Design Criteria, to provide the basis for each criterion and to explain the differences between the CRBR Criteria and the General Design Criteria of 10 CFR 50, Appendix A.

Paragraph 50.34 of 10 CFR 50 requires that the Preliminary Safety Analysis Report (PSAR) for each nuclear power plant list the Principal Design Criteria for that plant. The Principal Design Criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems and components important to safety; that is, structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public.

Appendix A to 10 CFR 50 provides a list of General Design Criteria which establish minimum requirements for the Principal Design Criteria for water-cooled nuclear power plants similar in design and location to plants for which construction permits have been issued by the Commission. The General Design Criteria are also considered to be generally applicable to other types of nuclear power units and are intended to provide guidance in establishing the Principal Design Criteria for such other units.

In July 1974, the staff developed and issued interim Principal Design Criteria for the CRBR plant. The criteria were based on (a) the General Design Criteria in Appendix A to 10 CFR 50, (b) General Design Criteria for LMFBR plants developed and issued for trial use and comment by the American Nuclear Society Standards Committee ANS-54, and (c) draft design safety criteria for the CRBR plant proposed by the applicant.

Based on the comments received on its interim criteria, the staff revised and issued in January 1976 Principal Design Criteria for the CRBR plant. Those criteria were included in Chapter 3.1 of the CRBR-PSAR as proposed by the applicant.

As part of the current review of the PSAR another assessment of the adequacy of the CRBR Principal Design Criteria has been made. The objective of this assessment has been to ensure that the criteria address all aspects of the design important to safety and meet the intent of paragraph 50.34 of 10 CFR 50.

For CRBR, compliance with the above has been based upon ensuring that the criteria:

a) establish requirements for those structures, systems and components (which are comparable to structures, systems, and components in LWRs) equivalent to or more conservative than the corresponding requirements for LWRs.

b) establish requirements for those structures, systems, and components unique to CRBR which are consistent with their importance to safety and which reflect an equivalent or more conservative safety approach than that generally applied to LWRs.

c) establish requirements on the CRBR design which will make the likelihood of core disruptive accidents sufficiently low that they can be excluded from the CRBR design basis.

The intent of the criteria is to express the broad requirements which must be met to ensure that the safety of CRBR is comparable to LWRs and that core disruptive accidents are of sufficiently low likelhood that they can be excluded from the plant design basis.

The resulting criteria represent the minimum design requirements acceptable to the staff for the CRBR plant and provide the point of departure for the development of detailed engineering criteria and final design.

The basic method and assumptions used in the development of this final set of Principal Design Criteria were as follows:

1) The criteria address only those structures, systems and components associated with accident for the prevention, to accommodate events within the

design basis and to make the likelihood of core disruptive accidents sufficiently low that they can be excluded from the CRBR design basis. Because the prevention of accidents, the selection of the design basis events and the reduction of the likelihood of accidents beyond the design basis become the key factors which dictate the necessary plant structures, systems and components proper selection of the types of design basis events and identification of the factors which can lead to accidents beyond the design basis is necessary to ensure a complete and adequate set of principal design criteria. Therefore, the approach used in selecting the design basis events, in identifying the factors which can lead to accidents beyond the design basis and in treating accidents beyond the design basis is considered important and is summarized below:

a) A set of design basis events was developed by the applicant and reviewed by the staff. These events define conditions under which the plant design is assessed and for which protective systems and/or features must be provided to ensure accommodation of the event. The design basis events include those that are expected to occur one or more times during the life of the plant (called normal operation, which includes anticipated operational occurrences) and those that are not expected to occur during the life of the plant but which are chosen as upper bound events for design purposes to envelop all events considered credible (called postulated accidents). The selection of the design basis events and their relative likelihood of occurrence involved such considerations as the CRBR design, experience at other nuclear power plants, likelihood of occurrence, plant lifetime and plant operating modes. The acceptability of these design basis events is based upon engineering judgment. The design basis events for CRBR are described in Chapter 15 of this report.

   Specific limits or acceptance criteria are established for determining the acceptability of the plant response to the design basis events. Different limits may be applied for different categories of design basis events. These limits are discussed elsewhere in this report.

b) The factors which can lead to core disruptive accidents in CRBR and those features necessary to make the likelihood of core disruptive accidents sufficiently low so that they can be excluded from the CRBR design basis was addressed by the staff in a letter R. P. Denise (NRC) to L. W. Caffey (CRBR Project Office - DOE), dated May 6, 1976. The principles discussed in that letter are embodied in the CRBR Principal Design Criteria.

c) The plant is also analyzed to determine its ability to withstand accidents beyond the design basis. The types of accidents analyzed, the acceptance criteria, the margin (and the addition of any features to the plant to provide additional margin) for accommodation are based on specific analysis of core disruptive accidents, along with engineering judgment. Design criteria for these additional features are addressed separately in Appendix __ to this SER.

2) The criteria were based upon the General Design Criteria for LWRs contained in Appendix A to 10 CFR 50. In the development of the CRBR criteria the staff considered the guidance in Appendix A to 10 CFR 50 as follows: (a) where there was not substantial difference between the CRBR plant and LWRs, the staff considered the LWR criteria applicable and adopted the appropriate criteria; (b) for those LWR criteria considered to be generally applicable to the CRBR plant, the staff adopted, to the maximum extent practicable, the LWR criteria with modifications to adapt them to CRBR; and (c) on the basis of its review, the staff identified and developed additional criteria for the CRBR plant where there were significant differences between LWR plants and the CRBR plant. The criteria in Appendix A were used to the maximum extent possible. Wording changes were made only to adapt the criteria to CRBR terminology, for completeness or to add additional requirements or conservatisms deemed appropriate due to the inherent differences between LWRs and CRBR, or (2) the more limited operating experience with LMFBRs versus LWRs. Adhering as closely as possible to the wording and requirements of the LWR criteria is considered appropriate because a level of safety equivalent to an LWR is the goal and the LWR criteria are implemented by existing

NRC guides and technical positions which could be impacted by changes in the criteria.

In addition, because the resolution of certain generic issues, such as station blackout, may affect the design criteria for all future plants, we did not try to prejudge resolution of these issues by modifying the Principal Design Criteria for CRBR to address these issues. Instead, we address them on a case-by-case basis in Appendix __ of this report.

3) Draft ANS Standard 54.1 "General Safety Design Criteria for an LMFBR Nuclear Power Plant," July 1981, was considered along with the Principal Design Criteria for FFTF and SEFOR. These criteria have been examined for their applicability to CRBR and, where appropriate, have been adopted.

The basis for a decision regarding the adequacy and completness of the CRBR criteria involves a judgement of whether the design basis event spectrum identifies those types of design basis events applicable to CRBR and whether the criteria (1) adequately address the safety function of those structures, systems and components associated with accident prevention and accommodation of the design basis events and (2) adequately address those factors which will reduce the likelihood of core disruptive accidents sufficiently that they can be excluded from the design basis.

The design basis event spectrum has been reviewed by the staff and is considered to be complete in addressing the various types of events which should be included in the design basis for CRBR. This conclusion is a judgment by the staff which considered such factors as experience at other nuclear power plants and the planned operating modes of CRBR and is discussed in more detail in Chapter 15 of this report. The design criteria are intended to address the design features necessary in the plant to accomplish the following basic safety functions:

(1) prevention of accidents
(2) shutdown the reactor
(3) remove decay heat
(4) containment of radioactive material

Other considerations affecting plant design such as sabotage and radiation protection of plant personnel are addressed in the Code of Federal Regulations and design criteria supplementing these requirements were not considered necessary. The completeness of the criteria is a judgment by the staff which considered the General Design Criteria of 10 CFR 50 Appendix A as guidance, the unique characteristics of CRBR, the factors discussed in the May 6, 1976 letter R. P. Denise to L. W. Coffey, draft ANS Standard 5.4.1 and the design criteria of FFTF and SEFOR in developing the CRBR criteria. In general, criteria equivalent to LWR criteria were developed except in the areas of reactor shutdown systems and decay heat removal where requirements more conservative than the corresponding LWR requirements were imposed upon CRBR to provide additional assurance that these functions are performed. These areas were chosen for additional conservatism due to the unique characteristics of CRBR (positive sodium void coefficient and potential for recriticality of molten fuel) which places added emphasis on performing these functions.

We believe that the Principal Design Criteria presented in this section establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety and will result in a CRBR design which presents a risk to public health and safety no greater than that from an LWR. If, in the future, new information bearing on these criteria comes to light which suggests modification, it will be handled on a case by case basis. This is consistent with the policy in 10 CFR 50 which acknowledges the possibility of addition to the GDCs.

In Section 3.1 of the PSAR the applicants have provided for each criterion a brief summary of how the CRBR design complies with the criterion. In many instances reference is made to other PSAR sections for the details. The staff review of the applicant's compliance is addressed in other sections of this SER as shown in Table 3.1-1.

TABLE 3.1-1 "TBD"

Listed below are the CRBR Principal Design Criteria. Provided with each is an identification of those changes from the 10 CFR 50, Appendix A, criteria a justification for its inclusion or a justification for omission for each criterion from 10 CFR 50, Appendix A, not included in the CRBR set.

CRBR Principal Design Criteria

A. Definitions

- Anticipated Operational Occurrences. Anticipated operational occurrences mean those conditions of normal operation which are expected to occur one or more times during the life of the nuclear power unit and include, but are not limited to, an inadvertent control rod withdrawal, tripping of sodium circulating pumps, loss of all offsite power, and tripping of the turbine generator set.

- Fuel Design Limits. Fuel design limits means those limits such as temperature, burnup, fluence, and cladding strain which are specified by the designer for normal operation and anticipated operational occurrences beyond which fuel rod failure may occur.

- Heat Transport System (HTS). The heat transport system is the aggregate of systems and/or components containing the heat transport fluids and used for extracting heat from the reactor and transporting it to the equipment used for electrical power conversion during normal operation or, after plant shutdown, to an ultimate heat sink. As such it includes the reactor residual heat extraction system. It does not include systems whose prime function is the cooling of structures or equipment.

- Intermediate Coolant Boundary. Intermediate coolant boundary means those components such as heat exchangers, piping, pumps, tanks, and valves which are (1) part of the intermediate coolant system or (2) connected to the intermediate coolant system up to and including any and all of the following:

  (a) The passive barrier between the intermediate coolant and the working fluid of other portions of the heat transport system.

  (b) The first valve normally closed or automatically isolable during normal reactor operation in piping which does not penetrate reactor containment.

  (c) The outermost containment isolation valve in piping which penetrates reactor containment.

- Intermediate Coolant System. Intermediate coolant system means those components such as intermediate pumps, steam generator, expansion tanks and connecting piping, which contain intermediate coolant and are necessary to transport core heat from the primary coolant system to the steam system.

- Normal Operation. Normal operation means steady state operation and those departures from steady state operation which are expected frequently or regularly in the course of power operation, refueling, maintenance, or maneuvering of the plant. It includes conditions

such as startup, normal shutdown, standby, load following, anticipated operational occurrences, operation with specific equipment out of service as permitted by Technical Specifications, and routine inspection, testing and maintenance of components and systems during any of these conditions, if it is consistent with the Technical Specifications.

- Nuclear Power Unit. A nuclear power unit means a nuclear power reactor and associated equipment necessary for electric power generation and includes those structures, systems, and components required to provide reasonable assurance the facility can be operated without undue risk to the health and safety of the public.

- Postulated Accidents. Postulated accidents means those events which, although not expected to occur, are selected, in addition to normal and anticipated operational occurrences for establishing design bases of systems, components and structures. They represent bounding events which envelop variations in the types of accidents considered and are the upper bound design basis events. Postulated accidents together with normal operation and anticipated operational occurrences represent the total spectrum of design basis events.

- Reactor Coolant Boundary. Reactor Coolant Boundary means those components such as the vessel, heat exchangers, piping, pumps, tanks, and valves which are (a) part of the reactor coolant system or (b) connected to the reactor coolant system up to and including any and all of the following:

  (a) The second of two (2) valves normally closed or automatically isolable during normal reactor operation.

  (b) The passive barrier between the reactor coolant and the working fluid of other portions of the heat transport system.

- Reactor Coolant System. Reactor coolant system means those components such as the reactor vessel, primary pumps, IHX, valves and connecting

piping, which contain primary radioactive coolant and are necessary to transport reactor core heat to the intermediate coolant system.

- Reactor Residual Heat Extraction System. The reactor residual heat extraction system is that portion of the HTS which, after plant shutdown, is capable of extracting heat from the reactor coolant and transporting this heat to an ultimate heat sink.

- Single Failure. A single failure means an occurrence which results in loss of capability of a component to perform its intended safety functions. Multiple failures resulting from a single occurrence are considered to be a single failure. Fluid and electric systems are considered to be designed against an assumed single failure if neither (1) a single failure of any active component (assuming passive components function properly) nor (2) a single failure of a passive component (assuming active components function properly), results in a loss of the capability of the system to perform its safety functions.[1]

B. CRBR Criteria

Criterion 1 - Quality Standard and Records. Structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. A quality assurance program shall be established and implemented in order to provide adequate assurance that these structures, systems and components will satisfactorily perform their safety functions. Appropriate records of the design, fabrication, erection, and testing of structures, systems and

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[1]Single failure of passive components in electric systems should be assumed in designing against a single failure. The conditions under which a single failure of a passive component in a fluid system should be considered in designing the system against a single failure is under development.

components important to safety shall be maintained by or under the control of the nuclear power unit licensee throughout the life of the unit.

Justification - This criterion is identical to Criterion 1 in 10 CFR 50, Appendix A. The intent of this criterion is to require work important to safety to be performed in a fashion which ensures the end product meets all the design and construction standards intended to apply. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 2 - Design Bases for Protection Against Natural Phenomena

Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions. The design bases for these structures, systems, and components shall reflect:

(1) appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated,

(2) appropriate combinations of the effects of normal and accident conditions with the effcts of the natural phenomena and

(3) the importance of the safety functions to be performed.

Justification - This criterion is identifical to Criterion 2 in 10 CFR 50, Appendix A. The intent of this criterion is to require that the plant be designed to withstand natural phenomena which could affect the ability of the plant's safety systems to perform their function. As such the criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 3 - Fire Protection. Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other

safety requirements, the probability and effect of fires and explosions. Noncombustible and heat resistant materials shall be used wherever practical throughout the unit, particularly in locations such as the containment and control room. Fire detection and fighting systems of appropriate capacity and capability shall be provided and designed to minimize the adverse effects of fires on structures, systems, and components important to safety. Fire fighting systems shall be designed to assure that their rupture or inadvertent operation does not significantly impair the safety capability of structures, systems, and components.

Justification - This criterion is identifical to Criterion 3 in 10 CFR 50, Appendix A. The intent of this criterion is to require that the plant be designed and constructed to minimize the affect of fires on plant systems and hardware important to safety. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 4 - Protection Against Sodium and NaK Reactions. Systems, components and structures containing sodium or NaK shall be designed and located to limit the consequences of chemical reactions resulting from a sodium or NaK spill. Special features such as inert atmosphere vaults shall be provided as appropriate for the reactor coolant system. Fire control systems and means to detect sodium, Nak or their reaction products shall be provided to limit and control the extent of such reactions to assure that the functions of components important to safety are maintained. Means shall be provided to limit the release of reaction products to the environment as necessary to protect plant personnel and to avoid undue risk to the public health and safety. Material which might come in contact with sodium or NaK shall be chosen to minimize the adverse effects of possible chemical reactions or microstructural changes. In areas where sodium or NaK chemical reactions are possible, structures, components and systems important to safety, including electrical wiring and components, shall be designed and located so that the potential for damage by sodium chemical reactions is minimized. Means shall be provided as appropriate to minimize possible contacts between sodium/NaK and water. A single failure of a passive boundary shall not permit the contact of primary coolant with water/steam. The effects of

possible interactions between sodium/Nak and concrete shall be considered in the design.

The sodium-steam generator system shall be designed to detect sodium-water reactions and limit the effects of the energy and reaction products released by such reactions so as to prevent loss of safety functions of the heat transport system.

Justification - Because of the use of sodium and NaK as coolants this criterion is unique to CRBR. The intent of this criterion is to require that the plant be designed and constructed with special consideration given to the affects of sodium and NaK including the detection, consequences and mitigating of sodium and NaK reactions and spills.

Due to the high chemical activity of sodium and NaK (reacts vigorously with water and oxygen) leaks or spills of this material can lead to chemical reactions, fires and combustion products not possible in LWRs. This high chemical activity requires that special measures be taken to prevent contact of the liquid metal with water, concrete and oxygen and to extinguish any liquid metal fires which do occur. In addition, means to detect liquid metal spills and to protect other plant equipment and personnel from the corrosive and potentially radioactive combustion products of liquid metal fires are required. Thus a new criterion addressing protection against liquid metal reactions is considered appropriate for CRBR.

This criterion has been modified from that in the PSAR to (1) include Nak systems as well as sodium systems (2) to add the words "and located" in the first sentence, (3) to add the words "or microstructural changes" in the fifth sentence and (4) to add the sentence "A single failure...with Water/Steam."

Criterion 5 - Environmental and Missile Design Bases. Structures, system and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, including anticipated operational occurrences, maintenance, testing, and postulated accidents including the affects of Na and NaK and their aerosols and combustion products. These structures, systems, and components shall be

appropriately protected against dynamic effects, such as the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

Justification - This criterion is identical to Criterion 4 in 10 CFR 50, Appendix A, except that (1) the words "including loss-of-coolant accidents" has been removed from the end of the first sentence since design features have been added to the plant to reduce the likelyhood of total loss of coolant accidents (see Criterion 27), (2) the words "including anticipated operational occurrences" have been added to the first sentence to ensure the criteria applies to all design basis events and (3) the words "including the affects of Na and NaK and their aerosols and combustion products" have been added to the first sentence to emphasize this unique aspect of CRBR. The intent of this criterion is to require that the plant be designed and constructed to withstand the effects of normal and abnormal operation without causing a loss of other plant systems or hardware important to safety. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

This criterion has been modified from that in the PSAR to add the words "including the... products" in the first sentence.

Criterion 6 - Sharing of Structures, Systems, and Components. Structures, systems and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

Justification - This criterion is identifical to Criterion 5 in 10 CFR 50, Appendix A. The intent of this criterion is to ensure that components and systems important to safety and shared by facilities will not preclude safe shutdown in one facility in the event of an accident in another facility. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 7 - Sodium Heating Systems. Heating systems shall be provided as necessary for systems and components important to safety which contain, or may be required to contain, sodium or sodium aerosol. The heating systems and their controls shall be appropriately designed with suitable redundancy to assure that the temperature distribution and rate of change of temperature in sodium systems and components are maintained within design limits assuming a single failure. The heating system shall be designed such that its failure will not impair the safety function of associated systems and components.

Justification - This criterion is unique to CRBR. The intent of this criterion is to require that systems important to safety which contain sodium or sodium aerosols and which require a controlled temperature in order for the system to perform its safety function be provided with a heating system capable of assuring that desired temperatures are maintained and designed to preclude overheating the components to which they are attached. Due to the fact that sodium freezes at 208°F, external heat is required to be supplied to the sodium systems under certain plant conditions to keep the sodium molten and to keep sodium aerosol from condensing and plugging flowpaths exposed to sodium vapor. Certain portions of the sodium and sodium cover gas systems are considered important to safety and require external heat to enable them to perform their function (examples-pressure relief lines and standby decay heat removal systems). Accordingly, a heating system is required which will maintain the desired temperature, provide sufficient instrumentation to verify these temperatures and not be an initiator of a failure of the sodium system. Thus a new criterion addressing requirements on sodium heating systems is considered appropriate for CRBR. This criterion has been modified from that in the PSAR to include sodium aerosol containing systems as well as sodium containing systems.

Criterion 8 - Reactor Design. The reactor and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

Justification - This criterion is identical to Criterion 10 in 10 CFR 50, Appendix A, except that the word "core" was removed in the first line so as not to imply this criteria should be limited to the core. The intent of this criterion is to require that fuel design limits not be exceeded during normal and anticipated operational occurrences. As such this criterion is not unique to LWRs and is
considered to apply to CRBR.

Criterion 9 - Reactor Inherent Protection. The reactor core and associated coolant systems shall be designed so that in the power operating range the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity.

Justification - This criterion is identical to Criterion 11 in 10 CFR 50, Appendix A. The intent of this criterion is to require the nuclear characteristics of the core provide a prompt negative nuclear feedback in response to positive reactivity insertions while the plant is operating in the power range. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 10 - Suppression of Reactor Power Oscillations The reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed.

Justification - This criterion is identical to Criterion 12 in 10 CFR 50, Appendix A. The intent of this criterion is to require the plant be designed to prevent power oscillations which could result in exceeding fuel design limits. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 11 - Instrumentation and Control. Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, including anticipated operational occurrences, and for postulated accident

conditions appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges.

Justification - This criterion is identical to Criterion 13 in 10 CFR 50, except that the words "for anticipated operational occurrences" have been changed to "including anticipated operational occurrences" to be consistent with the definitions, the word "postulated" has been added in front of the word "accident" to be consistent with the definitions and the word "pressure" has been removed from the phrase "reactor coolant pressure boundary"to use CRBR terminology. The intent of this criterion is to require sufficient instrumentation and control to monitor and maintain system variables within their prescribed values and also to monitor key parameters throughout normal and postulated accident ranges. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion has been modified from that in the PSAR to use the terminology "including anticipated operational occurrences."

Criterion 12 - Reactor Coolant Boundary. The reactor coolant boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, or rapidly propagating failure, and of gross rupture.

Justification This criterion is identical to Criterion 14 in 10 CFR 50, Appendix A, except that the word "pressure" has been removed from the phrase "reactor coolant pressure boundary" to use CRBR terminology. The intent of this criterion is to require high integrity of the reactor coolant boundary and low probability of gross rupture to maintain adequate core cooling and to contain the radioactive coolant. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 13 - Reactor Coolant System Design. The reactor coolant system and associated control, protection, auxiliary and sodium heating systems, shall be

designed with sufficient margin to assure that the design conditions of the reactor coolant boundary are not exceeded during any condition of normal operation, including anticipated operational occurrences.

Justification - This criterion is identical to Criterion 15 in 10 CFR 50, Appendix A, except that the words "and sodium heating systems" were added to address the CRBR design and the word "pressure" has been removed from the phrase "reactor coolant pressure boundary" to use CRBR terminology. The intent of this criterion is to require that the reactor coolant system and its associated systems be designed to preclude subjecting the reactor coolant boundary to condition in excess of its normal design conditions. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 14 - Containment Design. Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.

Justification - This criterion is identical to Criterion 16 in 10 CFR 50, Appendix A. The intent of this criterion is to require a reactor containment system to act as a final barrier against the uncontrolled release of radioactive material to the environment. The containment and associated systems includes the containment building,its penetrations and any systems that act as extensions of containment. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 15 - Electric Power Systems. An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant boundary are not exceeded as a result of normal operation, including anticipated operational

occurrences, and (2) the core is cooled, and containment integrity and other vital functions are maintained in the event of postulated accidents.

The onsite electric power supplies, including the batteries, and the onsite electric distribution system, shall have sufficient independence, redundancy, and testability to perform their safety functions, assuming a single failure.

Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights-of-way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable. Each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant boundary are not exceeded. One of the these circuits shall be designed to be available within a few seconds following any postulated accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.

Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

Justification - This criterion is identical to Criterion 17 in 10 CFR 50, Appendix A, except that the word "pressure" has been removed from the phrase "reactor coolant pressure boundary" to use CRBR terminology and reference to "loss-of-coolant accident" has been removed since criterion 27 requires features to reduce the likelihood of a total loss of coolant.

In addition, the words "normal operation, including" have been added to the second sentence to include all design basis events. The intent of this criterion is to require a highly reliable on-site and off-site electrical power system to ensure power to those systems and components important to safety. The reliability of the electrical power system is intended to be sufficiently high to support the requirements of the systems it serves. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

This criterion has been modified from that in the PSAR to add the words "normal operation, including" to the second sentence.

Criterion 16 - Inspection and Testing of Electric Power System. Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems shall be designed with a capability to test periodically (1) the operability and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system.

Justification - This criterion is identical to Criterion 18 in 10 CFR 50, Appendix A. The intent of this criterion is to require that the electric power systems for the plant be designed to allow for periodic testing and inspection to verify their operability. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 17 - Control Room. A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under postulated accident conditions (including those conditions addressed in NRC Criterion 4 - Protection Against Sodium and NaK Reactions). Adequate radiation protection

shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident.

Equipment at appropriate locations outside the control room shall be provided with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and with a design capability for subsequent control of the reactor at any coolant temperature lower than the hot shutdown condition.

Justification - This criterion is identical to Criterion 19 in 10 CFR 50, Appendix A, except: (1) the words "including loss-of-coolant accident" have been removed from the first sentence and replaced with words addressing sodium and NaK reactions since this is the main concern in a coolant leakage situation in CRBR, (2) the word "postulated" has been added in the first sentence to be consistent with the definitions, and (3) the last sentence has been changed to remove reference to cold shutdown and replace it with conditions applicable to CRBR.

The intent of this criteria is to require that the control room be designed to permit access and occupancy under all normal and postulated accident conditions and that in the event the control room is uninhabitable or that its reactor shutdown or decay heat removal functions cannot otherwise be performed, alternate shutdown locations, independent of the control room instrumentation and controls, be provided to perform those functions. As such the intent of this criterion is not unique to LWRs and with the above modifications is considered to apply to CRBR. This criterion has been modified from that in the PSAR to add the word "postulated" in the first sentence.

Criterion 18 - Protection System Functions. The protection system shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense postulated accident conditions and to initiate the operation of systems and components important to safety.

Justification - This criterion is identical to Criterion 20 in 10 CFR 50, Appendix A except that the word "postulated" has been added to item (2) to be consistent with the defintions. The intent of this criterion is to require the plant protection system to sense off normal conditions and automatically actuate appropriate protective systems important to safety. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion has been modified from that in the PSAR to include the word "postulated" in item (2).

Criterion 19 - Protection System Reliability and Testability. The protection system shall be designed for high functional reliability and inservice testability commensurate with the safety functions to be performed. Redundancy and independence designed into the protection system shall be sufficient to assure that (1) no single failure results in loss of the protection function and (2) removal from service of any component or channel does not result in loss of the required minimum redundancy unless the acceptable reliability of operation of the protection system can be otherwise demonstrated. The protection system shall be designed to permit periodic testing of its functioning when the reactor is in operation including a capability to test channels independently to determine failure and losses of redundancy that may have occurred.

Justification - This criterion is identical to Criterion 21 in 10 CFR 50, Appendix A. The intent of this criterion is to require a highly reliable plant protection system. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 20 - Protection System Independence. The protection system shall be designed to assure that the effects of natural phenomena and of normal operation, including anticipated operational occurrences, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function, or shall be demonstrated to be acceptable on some other defined basis. Design techniques, such as functional diversity or diversity in component design and principles of operation, shall be used to the extent practical to prevent loss of the protection function.

Justification - This criterion is identical to Criterion 22 in 10 CFR 50, Appendix A except that the words "including anticipated operational occurrences," have been added to the first sentence for completeness. The intent of this criterion is to require the plant protection system be designed to have diverse independent channels thus minimizing the potential for common mode failure. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion has been modified from that in the PSAR to add the words "including anticipated operational occurrences" in the first sentence.

Criterion 21 - Protection System Failure Modes. The protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, sodium, sodium reaction products, and radiation) are experienced.

Justification - This criterion is identical to Criterion 23 in 10 CFR 50, Appendix A, except the words "sodium, sodium reaction products" have been added to cover additional adverse environments possible on CRBR. The intent of this criterion is to require the plant protection system be designed in a fail safe fashion. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 22 - Separation of Protection and Control Systems. The protection system shall be separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component or channel which is common to the control and protection systems leaves intact a system satisfying all reliability, redundancy, and independence requirements of the protection system. Interconnection of the protection and control systems shall be limited so as to assure that safety is not significantly impaired.

Justification - This criterion is identical to Criterion 24 in 10 CFR 50, Appendix A. The intent of this criterion is to ensure that where a single random failure can cause a control system action that results in a generating

station condition requiring protective action and can also prevent proper action of a protection system channel designed to protect against the condition, the remaining redundant protection channels will be capable of providing the protective action even when degraded by a second random failure. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 23 - Protection System Requirements for Reactivity Control Malfunctions. The protection system shall be designed to assure that specified acceptable fuel design limits are not exceeded for any single malfunction of the reactivity control systems, such as accidental withdrawal of control rods.

Justification - This criterion is identical to Criterion 25 in 10 CFR 50, Appendix A, except that the words "(not ejection or dropout)" were removed since they do not apply to CRBR. The intent of this criterion is to require that the plant protection system be designed to terminate any anticipated operational occurrences involving the reactivity control system initiated by a single malfunction without exceeding acceptable fuel design limits. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 24 - Reactivity Control System Redundancy and Capability. Two independent reactivity control systems of different design principles shall be provided. One system shall be capable of independently and reliably sensing and responding to off normal conditions to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as a stuck rod, specified acceptable fuel design limits are not exceeded. The other system shall be capable of independently and reliably sensing and responding to off-normal conditions to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as a stuck rod the capability to cool the core is maintained. Each system shall have sufficient worth, assuming failure of any single active component, to shut down the reactor from any operating condition to zero power and maintain subcriticality at the hot shutdown temperature of the coolant, with allowance for the maximum reactivity associated with any anticipated operational occurrence or postulated

accident. One of the systems shall be capable of holding the reactor core subcritical for any coolant temperature lower than the Hot Shutdown temperature.

Justification - This criterion is similar to Criterion 26 in 10 CFR 50, Appendix A, with major changes as noted below. The words "(xenon burnout)" were removed since this is not a major concern in LMFBRs and the words "under cold conditions" at the end of the last sentence were replaced with the words "for any coolant temperature lower than the hot shutdown temperature" to use CRBR terminology to cover all expected conditions below the hot shutdown condition. In addition, the first paragraph was revised to require each reactivity control system be able to independently sense and terminate anticipated operational occurrences assuming a single failure. Also, the next to the last sentence was added to specify requirements on shutdown margin, thus ensuring that the reactivity control systems can insert sufficient worth to shutdown the reactor and overcome any positive reactivity inserted by the design basis event. The intent of this criterion is to require two independent reactivity control systems of different design each capable of responding to off normal events. One system is to maintain the fuel within acceptable design limits while the other system must maintain core coolability (assuming the first system does not respond). For each system this criterion pertains to both the sensing portion of the system (including its associated electronics and logic) and the mechanical portion of the system. This is a more conservative criterion than applied to LWRs. It is the staff's position that due to the inherent differences in nuclear characteristics between LWRs and CRBR (i.e. positive Na void coefficient and potential for recriticality) two independent, diverse, redundant shutdown systems should be provided for CRBR, to reduce the likelyhood of failure to scram. As such this criterion, as modified, is considered appropriate for CRBR. This criterion has been modified from that in the PSAR to (1) remove the words "(include xenon burnout)" in the third sentence, (2) to add the next to the last sentence, (3) to modify the first paragraph to require each system independently be able to sense and terminate anticipated events and (4) to modify the last sentence to use terminology for CRBR.

Criterion 25 - Reactivity Control Systems Capability. The reactivity control systems shall be designed to have an independent capability of reliably sensing

and responding to off-normal conditions to assure that under postulated accident conditions and with appropriate margin for malfunctions such as a stuck rod, the capability to cool the core is maintained.

Justification - This criterion is similar to Criterion 27 in 10 CFR 50, Appendix A, with the major changes being: (1) the words "in conjunction with poison addition by the emergency core cooling system" have been removed since CRBR does not have an emergency core cooling system, and (2) the requirment for a combined capability has been modified to require that each system independently be capable of sensing and shutting down the reactor in response to postulated accident conditions (assuming a single failure) for the same reason as stated in the justification to Criterion 24 above. As such, this criterion as modified is considered appropriate for CRBR. This criterion has been modified from that in the PSAR to require each system independently be able to sense and shutdown the reactor in response to postulated accident conditions.

Criterion 26 - Heat Transport System Design. The heat transport system shall be designed to reliably remove heat from the reactor and transport the heat to the turbine-generator or ultimate heat sinks under all plant conditions of normal operation, including anticipated or tional occurrences, and postulated accidents. Consideration shall be given to provision of independence and diversity to provide adequate protection against common mode failures. The system safety functions shall be to:

(1) Provide sufficient cooling to prevent exceeding specified acceptable fuel design limits during normal operation and following anticipated operational occurrences, and

(2) Maintain integrity of the reactor coolant boundary sufficient to provide adequate core cooling following postulated accidents.

Following the loss of a flow path, the heat transport system shall include at least two independent flow paths, each capable of performing the safety functions following shutdown.*

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*This requirement is not intended to preclude two-loop operation provided the system safety functions can be appropriately met.

The system shall include suitable interconnections, leak detection, isolation and containment capability to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electrical power system operation (assuming onsite power is not available) the safety function can be accomplished, assuming a single failure.

Justification - This criterion is unique to CRBR. The intent of this criterion is to assure that the HTS be designed for normal operation, anticipated operational occurrences and be able to withstand postulated accidents and that at least two flow paths be available for decay heat removal. In CRBR the HTS is the means of removing reactor heat during all normal and off-normal conditions. No system equivalent to an emergency core cooling system is provided. Accordingly, it is considered important that the HTS be able to accommodate all design basis events assuming a single failure and a Principal Design Criterion addressing this point is considered appropriate. This criterion has been modified from that in the PSAR to remove the word "electric" in the last sentence so as not to imply electric interconnections had to be made and to modify item (2) to not imply that coolant leaks from the HTS are excluded from the design basis.

Criterion 27 - Assurance of Adequate Reactor Coolant Inventory. The reactor coolant boundary and associated components, control and protection systems shall be designed to limit loss of reactor coolant so that an inventory adequate to perform the safety functions of the heat transport system is maintained under normal operation, including anticipated operational occurrences, and postulated accident conditions.

Justification - This criterion is unique to CRBR. The intent of this criterion is to require that the HTS design provide for retention of sufficient sodium inventory (in the event of a leak) to assure adequate decay heat removal capability. Since leaks in the coolant system do not lead to the coolant flashing to vapor a coolant makeup system or an ECCS similar to LWRs is not required for

CRBR provided that it can be shown that leaks in the coolant system do not lead to uncovering the core or loss of core cooling. To show the above it is necessary to design the plant for sufficient retention of coolant inventory in the event of a leak to maintain a decay heat removal path. This involves ensuring the physical design of the system includes features (such as elevated piping, guard vessels and expansion tanks) that preclude loss of coolant inventory that could lead to inadequate core cooling. This criterion requires such features be a part of the CRBR design and is considered appropriate for a principal design criteria.

Criterion 28 - Quality of Reactor Coolant Boundary. Components which are part of the reactor coolant boundary shall be designed, fabricated, erected, and tested to the highest quality standards practical. Means shall be provided for detecting and to the extent practical, identifying the location of the source of reactor coolant leakage.

Justification - This criterion is identical to Criterion 30 in 10 CFR 50, Appendix A. The intent of this criterion is to require the use of quality standards in the design, fabrication and testing of primary reactor coolant boundary components and to provide the capability to detect leaks in the system. For CRBR this criterion has an additional intent, namely that of minimizing the likelihood of leaks greater than those assumed in the design basis. As such this criterion is not considered unique to LWRs and is considered to apply to CRBR.

Criterion 29 - Fracture Prevention of Reactor Coolant Boundary. The reactor coolant boundary shall be designed with sufficient margin to assure that when stressed under normal operation, including anticipated operational occurrences, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a nonbrittle manner and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures, service degradation of material properties, creep, fatigue, stress-ruture and other conditions of the boundary material under normal operation, including anticipated operational occurrences, maintenance, testing, and postulated accident conditions and the uncertainties in determining (1) material

properties, (2) the effects of coolant chemistry and irradiation on material properties, (3) residual, steady state and transient stresses, and (4) size of flaws.

Justification - This criterion is identical to Criterion 31 in 10 CFR 50, Appendix A, except that the words "including anticipated operational occurrences" were added in the first and second sentences to include all design basis events and the words "service degradation of material properties, creep, fatigue, stress-rupture" and "effects of coolant chemistry" were added in the second sentence to address the unique concerns of CRBR due to the high design and operating temperature of the system and the use of sodium as a coolant. The intent of this criteria is to require the primary reactor coolant boundary components be designed to avoid brittle and rapidly propagating fracture modes, thus minimizing the likelihood of leaks greater than those assumed in the design basis. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion has been modified from that in the PSAR to add the words "including anticipated operational occurrences" in the first and second sentences and the words "fatigue, stress-rupture" in the second sentence.

Criterion 30 - Inspection of Reactor Coolant Boundary. Components which are part of the reactor coolant boundary shall be designed to permit (1) periodic inspection and testing of areas and features important to safety, to assess their structural and leaktight integrity, and (2) an appropriate material surveillance program.

Justification - This criterion is identical to Criterion 32 in 10 CFR 50, Appendix A, except that the words "pressure" and "for the reactor pressure vessel" were removed to use terminology applicable to CRBR and since the inspection requirements are intended to apply to the entire primary boundary not just the reactor vessel. The intent of this criterion is to require that the design allow for periodic inspection and an appropriate material surveillance program for the primary coolant boundary. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 31 - Intermediate Coolant System. The intermediate coolant system shall be designed to transport heat reliably from the reactor coolant system to the steam/feedwater systems as required for the reactor coolant system to meet its safety functions under all plant conditions of normal operation, including anticipated operational occurrences, and postulated accident conditions. The intermediate coolant system shall contain coolant that is not chemically reactive with the reactor coolant.

A pressure differential shall be maintained across a passive boundary between the reactor coolant system and the intermediate coolant system such that any leakage would tend to flow from the intermediate coolant system to the reactor coolant system unless other provisions can be shown to be acceptable on some defined basis.

Justification - This criterion is unique to CRBR since LWRs do not have intermediate loops. The intent of this criterion is to require an intermediate heat transfer loop between the steam system and the reactor coolant system, to require the intermediate system have greater pressure than the primary loop (thus preventing the leakage of radioactive sodium into the non-radioactive intermediate system) and a coolant that will not react chemically with the primary sodium.

In CRBR heat from the reactor coolant system is transferred to an intermediate sodium loop and then to the steam system. The main purpose in having an intermediate loop is to separate the radioactive primary sodium from the steam thus avoiding the possibility of a sodium-water reaction involving radioactive sodium. To help accomplish this function the intermediate system pressure is also maintained higher than the pressure in the reactor coolant system. Given such a loop it is also necessary that it reliably transfer reactor heat to the steam system to meet its safety function for decay heat removal. Additionally, since there are no containment isolation valves in the intermediate system it is considered a closed system and acts as an extension of containment. Given these important safety functions the application of a criterion on the intermediate system is considered appropriate for CRBR. This criterion has been

changed from that in the PSAR to replace the words "reactor residual heat extraction" with "steam/feedwater" in the first sentence for clarity.

Criterion 32 - Fracture Prevention of Intermediate Coolant Boundary. The intermediate coolant boundary shall be designed with sufficient margin to assure that when stressed under normal operation, including anticipated operational occurrences, maintenance, testing, and postulated accident conditions, (1) the boundary behaves in a non-brittle manner and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures, service degradation of material properties, creep, fatigue, stress rupture, and other conditions of the boundary material under normal operation, including anticipated operational occurrences, maintenance, testing, and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of coolant chemistry and irradiation on material properties and (3) residual, steady-state and transient stresses, and (4) size of flaws.

Justification - This criterion is unique to CRBR since LWRs do not have intermediate loops. It is identical to CRBR Criterion 29 on the reactor coolant boundary. The intent of this criterion is to require the intermediate coolant boundary components be designed to avoid brittle and rapidly propagating fracture modes. Since the intermediate system provides important safety functions (i.e., decay the removal path and isolation of the radioactive reactor coolant from the steam system) a criterion on fracture prevention similar to that on the reactor coolant system is considered appropriate for CRBR. This criterion has been modified slightly from that in the PSAR to make it identical to the fracture prevention criterion for the reactor coolant system (Criterion 29).

Criterion 33 - Inspection and Surveillance of Intermediate Coolant Boundary. Components which are part of the intermediate coolant boundary shall be designed to permit (1) periodic inspection of areas and features important to safety, to assess their structural and leak-tight integrity, and (2) an appropriate material surveillance program for the intermediate coolant boundary. Means shall be provided for detecting intermediate coolant leakage.

Justification - This criterion is unique to CRBR since LWRs do not have intermediate loops. It is similar to CRBR Criterion 30 on the primary reactor coolant boundary. The intent of this criterion is to require that the design allow for periodic inspection, an appropriate material surveillance program and leak detection capability. Since the intermediate system provides important safety functions a criterion on inspection, surveillance and leak detection similar to that on the primary system is considered appropriate for CRBR.

Criterion 34 - Reactor and Intermediate Coolant and Cover Gas Purity Control. Systems shall be provided to monitor and maintain reactor and intermediate coolant and cover gas purity within specified design limits. These limits shall be based on consideration of (1) chemical attack, (2) fouling and plugging of passages, (3) radio-nuclide concentrations, and (4) detection of sodium-water reactions.

Justification - This criterion is unique to CRBR. The intent of this criterion is to require the plant to have systems to monitor and maintain the purity of the reactor and intermediate sodium and of the cover gas for the reactor coolant and intermediate system. The purity of the sodium coolant directly affects the corrosion rate of the components exposed to the sodium. Since the design of the plant takes into consideration an allowance for corrosion the purity of the sodium must be monitored and kept within a range consistent with the corrosion allowance. In addition, sodium with a high level of impurities can tend to plug flow passages in cooler areas of the system and thus it is important to maintain the Na plugging temperature below the minimum sodium temperature in the system. The purity of the sodium cover gas affects the purity of the sodium, the formation of sodium compounds in the cover gas space (with a resulting potential for blockage of gas flow paths), the ability to detect fission gas leakage from fuel or blanket pins and the ability to detect sodium water reactions in the steam generators. Maintaining limits on cover gas purity is thus required to ensure certain plant safety systems operate as designed. In consideration of the above this criterion was considered appropriate for CRBR.

Criterion 35 - Reactor Residual Heat Extraction System. A reactor residual heat extraction system shall be provided to reliably transfer residual heat from the reactor coolant system to ultimate heat sinks under all plant shutdown conditions following normal operation, including anticipated operational occurrences, and postulated accident conditions. A passive boundary shall normally separate reactor coolant from the working fluids of the reactor residual heat extraction system. Any fluid in the residual heat extraction system that is separated from the reactor coolant by a single passive barrier shall not be chemically reactive with the reactor coolant.

Suitable redundancy, independence and diversity in systems, components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electrical power system operation (assuming offsite power is not available) and for offsite electrical power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure, with at least two flow paths remaining available for residual heat removal.*

Justification - This criterion is comparable to Criterion 34 in 10 CFR 50, Appendix A, except that (1) the word "reliably" was added to the first sentence to specify reliability is a design goal, (2) the third sentence was added to address coolant compatability, (3) the words "independence and diversity in systems" were added to the second paragraph to require independence and diversity be provided as necessary in decay heat removal paths for reliable decay heat removal and (4) the words "with at least 2 flow paths remaining available for residual heat removal" were added to the second paragraph to specify the minimum redunancy. The intent of this criterion is to require reliable means of removing reactor decay heat assuming loss of offsite or onsite power and a single failure which could remove one or more of the four available flow paths from service. As such this criterion requires such systems be part of the CRBR design.

*This requirement is not intended to preclude two-loop operation provided the system safety functions can be appropriately met.

The requirement for independence, diversity and at least two flow paths was added to help minimize the probability of a loss of cooling event which could lead to core disruption. It is the staff's position that at least two heat removal paths remain available following a design basis event and a single failure to provide additional margin for accommodation of failures in the decay heat removal paths. This is a more conservative position than for LWRs and is considered appropriate since on CRBR a loss of core cooling can lead to a core configuration more reactive than a similar event in a LWR. The statement on coolant compatability was added to require that the potential for chemical reactions with the radioactive primary coolant be minimized. This is consistent with a similar requirement on the intermediate HTS (PDC #31). This criterion has been modified from that in the PSAR to add the word "reliably" in the first sentence, to add the third sentence on coolant compatibility, to add the words "independence and diversity in systems" in the second paragraph and to add "with at least 2 flow paths remaining available for residual heat removal" in the fourth sentence.

Criterion 36 - Inspection of Reactor Residual Heat Extraction Systems. The reactor residual heat extraction system shall be designed to permit appropriate periodic inspection of important components, such as heat exchangers and piping, to assure integrity and capability of the system.

Justification - This criterion is unique to CRBR. The intent of this criterion is to require that the design of the systems for reactor decay heat removal allow provision for periodic inspection of piping and components to ensure the system intergrity is intact. Having the capability to adequately remove reactor decay heat is important to safety, both on LWRs and on sodium cooled plants; however, because of the added concern of geometry changes and recriticality on loss of core cooling in CRBR periodic inspection of these systems for integrity and capability is considered appropriate.

Criterion 37 - Testing of Reactor Residual Heat Extraction System. The reactor residual heat extraction system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leak-tight integrity of its components, (2) the operability and the performance of the active components of the system, and (3) the operability of the complete

system, and under conditions as close to design as practical, the performance of the full operational sequence that brings the system into operation for reactor shutdown and following postulated accidents, including operation of applicable portions of the protection system and the transfer between normal and emergency power sources.

Justification - This criterion is unique to CRBR. The intent of this criterion is to require that the design of the paths for reactor decay heat removal allow provision for periodic testing to ensure they perform as designed. Having the capability to adequately remove reactor decay heat is important to safety, and in view of the concerns expressed in the discusion of Criteria 35 and 36 above, requiring periodic testing of these paths is considered appropriate for CRBR.

Criterion 38 - Additional Cooling Systems. In addition to the heat rejection capability provided by the reactor residual heat extraction system, systems to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided, as necessary. The system safety function shall be to transfer the combined heat load of these structures, systems, and components as required for safety under normal operation, including anticipated operational occurrences, and postulated accident conditions.

Suitable redundancy in components and features, and suitable interconnections, leak detection, and isolation capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

Justification - This criterion is identical to Criterion 44 in 10 CFR 50, Appendix A, except that (1) its applicability and title has been extended to cover all additional cooling systems, not just cooling water, (2) the first sentence has been modified to specifically exclude the reactor residual heat extraction system (since it is addressed in Criterion 35, 36 and 37) and to add the words "as necessary" at the end of the sentence, and (3) the second sentence has been modified to add the words "including anticipated operational

occurrences and postulated" to make it clear that all design basis events are included. The intent of this criterion is to require cooling to other components and systems important to safety (which require a controlled temperature in order for them to perform their safety function) assuming loss of offsite or onsite power and a single failure. The reliability of the additional cooling systems is intended to be sufficient to support the requirements of the systems it serves. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion has been modified from that in the PSAR to add the words "including anticipated operational occurrences and postulated" in the second sentence.

Criterion 39 - Inspection of Additional Cooling Systems. The additional cooling systems shall be designed to permit appropriate periodic inspection of important components, such as heat exchangers and piping, to assure the integrity and capability of the systems.

Justification - This criterion is identical to Criterion 45 in 10 CFR 50, Appendix A, except that the applicability has been extended to cover all additional cooling systems, not just cooling water. The intent of this criterion is to require the design of cooling systems which provide cooling to components and systems important to safety allow provisions for periodic inspection of important components. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 40 - Testing of Additional Cooling Systems. The additional cooling systems shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of their components, (2) the operability and the performance of the active components of the systems, and (3) the operability of the complete systems as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system and the transfer between normal and emergency power sources.

Justification - This criterion is identical to Criterion 46 of 10 CFR 50, Appendix A, except that the applicability has been extended to cover all additional cooling systems, not just cooling water, and the words "for reactor shutdown and for loss-of-coolant accidents" have been removed so as not to limit the testing to those conditions. The intent of this criterion is to require the design of the cooling systems which provide cooling to components and systems important to safety allow provisions for periodic testing to assure the system still performs as designed. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 41 - Containment Design Basis. The reactor containment structure, including access openings and penetrations, and if necessary, in conjunction with additional post accident heat removal systems including ex-vessel systems, shall be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate, and with sufficient margin, the calculated pressure and temperature conditions resulting from normal operation, including anticipated operational occurrences, and any of the postulated accidents. This margin shall reflect consideration of (1) the effects of potential energy sources which have not been included in the determination of the peak conditions, such as decay heat in released fission products, potential spray or aerosol formation, and potential exothermic chemical reactions; (2) the limited experience and experimental data available for defining accident phenomena and containment responses; and (3) the conservatism of the calculational model and input parameters.

Justification - This criterion is identical to Criterion 50 in 10 CFR 50, Appendix A, except that the first sentence has been changed to add the word "including" between "operation" and "anticipated" to be consistent with the definition of anticipated operational occurrences,to not refer to the containment heat removal system but rather to the more general term of post accident heat removal systems and the second sentence has been changed to not refer to metal-water reactions and emergency core cooling but rather to conditions applicable to CRBR such as decay heat, spray and aerosol formation and potential exothermic chemical reactions. The intent of this criterion is to require the containment building and any associated penetrations or extensions be designed

to accommodate with margin the conditions resulting from all postulated accidents. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 42 - Fracture Prevention of Reactor Containment Boundary. The reactor containment boundary shall be designed with sufficient margin to assure that under normal operation, including anticipated operational occurrences, maintenance, testing, postulated accident conditions (1) its metallic materials behave in a nonbrittle manner and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the containment boundary material during normal operation, including anticipated operational occurrences, maintenance, testing, and postulated accident conditions, and the uncertainties in determining (1) material properties, (2) residual, steady-state, and transient stresses, and (3) size of flaws.

Justification - This criterion is identical to Criterion 51 to 10 CFR 50, Appendix A, except that in item (1) the word "ferritic" has been changed to "metallic" to be less specific on the containment material and the words "including anticipated operational occurrences" have been added in the first and second sentence to include all design basis events. The intent of this criterion is to require that the containment building design provide sufficient margin to avoid brittle failure under all postulated loading conditions. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion has been modified from that in the PSAR to add the words "including anticipated operational occurrences" in the first and second sentences.

Criterion 43 - Capability for Containment Leakage Rate Testing. The reactor containment and other equipment which may be subjected to containment test conditions shall be designed so that periodic integrated leakage rate testing can be conducted at containment design pressure.

Justification - This criterion is identical to Criterion 52 in 10 CFR 50, Appendix A. The intent of this criterion is to require the containment building and equipment internal to it be designed to allow periodic leak

testing to verify its integrity. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 44 - Provisions for Containment Testing and Inspection. The reactor containment shall be designed to permit (1) appropriate periodic inspection of all important areas, such as penetrations, (2) an appropriate surveillance program, and (3) periodic testing at containment design pressure of the leaktightness of penetrations which have resilient seals and expansion bellows.

Justification - This criterion is identical to Criterion 53 in 10 CFR 50, Appendix A. The intent of this criterion is to require the containment building be designed to permit periodic inspection and leak testing of individual penetrations which rely on resilient seals or bellows seals. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 45 - Piping Systems Penetrating Containment. Piping systems penetrating reactor containment shall be provided with leak detection, isolation, and containment capabilities having redundancy, reliability, and performance capabilities which reflect the important to safety of isolating these piping systems. Such piping systems shall be designed with a capability to test periodically the operability of the isolation valves and associated apparatus and to determine if valve leakage is within acceptable limits.

Justification - This criterion is identifical to Criterion 54 to 10 CFR 50, Appendix A. The intent of this criterion is to require that piping penetrations through the containment building be designed to be isolable, if necessary for safety, and that the isolation valves be capable of periodic leak testing. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 46 - Reactor Coolant Boundary Penetrating Containment. Each line that is part of or directly connected to the reactor coolant boundary and that penetrates reactor containment shall be provided with containment isolation valves as follows, unless it can be demonstrated that the containment isolation

provisions for a specific class of lines, such as instrument lines, are acceptable on some other defined basis:

(1) One locked closed isolation valve inside and one locked closed isolation valve outside containment, or

(2) One automatic isolation valve inside and one locked closed isolation valve outside containment, or

(3) One locked closed isolation valve inside and one automatic isolation valve outside containment. A simple check valve may not be used as the automatic isolation valve outside containment, or

(4) One automatic isolation valve inside and one automatic isolation valve outside containment. A simple check valve may not be used as the automatic isolation valve outside containment.

Isolation valves outside containment shall be located as close to containment as practical and upon loss of actuating power, automatic isolation valves shall be designed to take the position that provides greater safety.

Other appropriate requirements to minimize the probability or consequences of an accidental rupture of these lines or of lines connected to them shall be provided as necessary to assure adequate safety. Determination of the appropriateness of these requirements, such as higher quality in design, fabrication, and testing, additional provisions for inservice inspection, protection against more severe natural phenomena, and additional isolation valves and containment shall include consideration of the population density, use characteristics, and physical characteristics of the site environs.

Justification - This criterion is identical to Criterion 55 in 10 CFR 50, Appendix A, except that the words "or directly connected to" have been added in the first sentence to also include supporting systems (such as drain lines and purification system lines) which are connected to and contain primary reactor coolant. The intent of this criterion is to provide guidance on acceptable

configurations for isolation valves for piping systems containing primary reactor coolant which penetrate the containment building. As such it is not unique to LWRs and is considered to apply to CRBR.

Criterion 47 - Primary Containment Isolation. Each line that connects directly to the containment atmosphere and penetrates primary reactor containment shall be provided with containment isolation valves as follows, unless it can be demonstrated that the containment isolation provisions for a specific class of lines, such as instrument lines, are acceptable on some other defined basis:

(1) One locked closed isolation valve inside and one locked closed isolation valve outside containment, or

(2) One automatic isolation valve inside and one locked closed isolation valve outside containment, or

(3) One locked closed isolation valve inside and one automatic isolation valve outside containment. A simple check valve may not be used as the automatic isolation valve outside containment, or

(4) One automatic isolation valve inside and one automatic isolation valve outside containment. A simple check valve may not be used as the automatic isolation valve outside containment.

Isolation valves outside containment shall be located as close to the containment as practical and upon loss of actuating power, automatic isolation valves shall be designed to take the position that provides greater safety.

Justification - This criterion is identical to Criterion 56 in 10 CFR 50, Appendix A. The intent of this criterion is to provide guidance on acceptable configurations for isolation valves for piping systems which penetrate the containment building and which are open to the containment atmosphere. As such it is not unique to LWRs and is considered to apply to CRBR.

Criterion 48 - Closed System Penetrating Containment. Each line that penetrates primary reactor containment and is neither part of nor directly connected to the reactor coolant boundary, nor connected directly to the containment atmosphere shall have at least one containment isolation valve, unless it can be demonstrated that containment isolation provisions for a specific class of lines are acceptable on some other defined basis. The isolation valve, if required, shall be either automatic or locked closed or capable of remote manual operation. This valve shall be outside containment and located as close to the containment as practical. A simple check valve may not be used as the automatic isolation valve.

Justification - This criterion is identical to Criterion 57 in 10 CFR 50, Appendix A, except that (1) the words "nor directly connected to" have been added to the first sentence to exclude other systems which penetrate containment and which contain primary coolant since they are addressed in Criterion 46 and (2) a provision to allow an alternate scheme for isolation has been added to allow more flexibility in meeting this requirement. The intent of this criterion is to provide guidance on acceptable containment isolation valve configurations for piping systems not open to containment atmosphere and not containing primary reactor coolant. As such this criterion is not unique to LWRs and is considered applicable to CRBR.

Criterion 49 - Containment Atmosphere Cleanup. Systems to control fission products, hydrogen, oxygen, Na aerosols or combustion products and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents, and to control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained. The necessity of such systems should consider the effects of sodium leakage and its potential reaction with oxygen and its potential for hydrogen generation when in contact with concrete.

Each system shall have suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) its safety function can be accomplished, assuming a single failure.

Justification - This criterion is identical to Criterion 41 in 10 CFR 50, Appendix A, except that the words "Na aerosols or combustion products" have been added in the first sentence and the second sentence has been added to address the effects of sodium which is unique to CRBR. The intent of this criterion is to require systems to control the composition of the containment atmosphere thus minimizing the potential for violating containment integrity and reducing the concentration of fission products in the atmosphere. This in turn leads to lower releases to the outside amtosphere. As such this criterion is not unique to LWRs and is considered applicable to CRBR. This criterion has been modified from that in the PSAR to add the words "Na aerosols or combustion products" in the first sentence.

Criterion 50 - Inspection of Containment Atmosphere Cleanup Systems. The containment atmosphere cleanup systems shall be designed to permit appropriate periodic inspection of important components, such as filter frames, ducts, and piping to assure the integrity and capability of the systems.

Justification - This criterion is identical to Criterion 42 in 10 CFR 50, Appendix A. The intent of this criterion is to require the design of containment atmosphere cleanup systems allow provision for periodic inspection of important components. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 51 - Testing of Containment Atmosphere Cleanup Systems. The containment atmosphere cleanup systems shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of components, (2) the operability and performance of the active components of the systems such as fans, filters, dampers, pumps, and

valves and (3) the operability of the systems as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of associated systems.

<u>Justification</u> - This criterion is identical to Criterion 43 in 10 CFR 50, Appendix A. The intent of this criterion is to require the design of the containment atmosphere cleanup systems allow provision for periodic testing to assure the system performs as designed. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

<u>Criterion 52 - Control of Releases of Radioactive Materials to the Environment</u>. The nuclear power unit design shall include means to control suitably the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid wastes produced during normal reactor operation, including anticipated operational occurrences. Sufficient holdup capacity shall be provided for retention of gaseous and liquid effluents containing radioactive materials, particularly where unfavorable site environmental conditions can be expected to impose unusual operational limitations upon the release of such effluents to the environment.

<u>Justification</u> - This criterion is identical to Criterion 60 in 10 CFR 50, Appendix A. The intent of this criterion is to require the plant have provisions for the controlled release of gaseous, liquid and solid radioactive waste. As such this criterion is not unique to LWRs and is considered applicable to CRBR.

<u>Criterion 53 - Fuel Storage and Handling and Radioactivity Control</u>. The fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal operation, including anticipated operational occurrences, and postulated accident conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety, (2) with suitable shielding for radiation protection, (3) with appropriate

containment, confinement, and filtering systems, (4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, (5) to prevent significant reduction in fuel storage coolant inventory under accident conditions. The fuel handling and its interfacing systems shall be designed to minimize the potential for fuel management errors that could result in fuel rod failure.

Justification - This criterion is identical to Criterion 61 to 10 CFR 50, Appendix A except that the words "operation, including anticipated operational occurrences" have been added in the first sentence to make it clear that all design basis events are included and the last sentence was added to require features to minimize fuel management errors so that such errors can be eliminated from the CRBR design basis event spectrum. The intent of this criterion is to provide design guidelines for the fuel storage, fuel handling, radioactive waste and other systems containing radioactivity and to require design features to minimize the potential for fuel management errors which could lead to fuel rod failure. As such it is not unique to LWRs and is considered to apply to CRBR. This criterion has been modified from that in the PSAR to add the words "operation, including anticipated operational occurrences" in the first sentence and to add the last sentence.

Criterion 54 - Prevention of Criticality in Fuel Storage and Handling. Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations.

Justification - This criterion is identical to Criterion 62 in 10 CFR 50, Appendix A. The intent of this criterion is to require positive means of preventing criticality in the fuel storage, handling and refueling process. As such it is not unique to LWRs and is considered to apply to CRBR.

Criterion 55 - Monitoring Fuel and Waste Storage. Appropriate systems shall be provided in fuel storage and radioactve waste systems and associated handling areas (1) to detect conditions that may result in loss of residual heat removal

capability and excessive radiation levels and (2) to initiate appropriate safety actions.

Justification - This criterion is identical to Criterion 63 in 10 CFR 50, Appendix A. The intent of this criterion is to require monitoring of fuel and waste storage systems to ensure adequate heat removal and non-excessive radiation levels. As such it is not unique to LWRs and is considered to apply to CRBR.

Criterion 56 - Monitoring Radioactivity Releases. Means shall be provided for monitoring the reactor containment atmosphere, effluent discharge paths, and the plant environs for radioactivity that may be released from normal operations, including anticipated operational occurrences, and from postulated accidents.

Justification - This criterion is identical to Criteria 64 in 10 CFR 50, Appendix A, except that the words "spaces containing components for recirculation of loss-of-coolant accident fluid" have been removed since CRBR does not require such spaces and the word "including" has been added between "operation" and "anticipated" to be consistent with the definition of anticiated operational occurrences. The intent of this criterion is to require monitoring capability to detect and measure the radioactivity discharged to the plant environment and discharged from the plant's effluent paths to the outside atmosphere. As such this criterion is not unique to LWRs and is considered to apply to CRBR.

Criterion 57 - Reactivity Limits. The reactivity control systems shall be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in damage to the reactor coolant boundary greater than limited local yielding nor (2) sufficiently disturb the core, its support structures or other reactor vessel internals to impair significantly the capability to cool the core. These postulated reactivity accidents shall include consideration of events such as rod runout, steamline rupture, changes in reactor coolant temperature and pressure, cold sodium addition.

Justification - This criterion is identical to Criterion 28 in 10 CFR 50, Appendix A, except that the words "rod dropout" have been changed to "rod runout" and the words "cold water addition" have been changed to "cold sodium addition" to be consistent with CRBR terminology. Also the word "pressure" has been dropped from the terms "pressure boundary" and "pressure vessel." and the words "rod ejection (unless prevented by positive means)" have been dropped from the last sentence since they do not apply for CRBR due to the low system operating pressure. The intent of this criterion is to require that the plant systems which can add reactivity to the core be designed to limit reactivity insertions to values that are consistent with the capability of the protection systems and will not result in loss of coolant boundary or affect the ability to cool the core. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion represents a new criterion from those in the PSAR which in the staff's judgment should be applied to CRBR.

Criterion 58 - Protection Against Anticipated Operational Occurrences. The protection and reactivity control systems shall be designed to assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences.

Justification - This criterion is identical to Criterion 29 in 10 CFR 50, Appendix A. The intent of this specification is to require highly reliable protection and reactivity control systems. As such this criterion is not unique to LWRs and is considered to apply to CRBR. This criterion represents a new criterion from those in the PSAR which in the staff's judgment should be applied to CRBR.

Criterion 59 - Fuel Rod Failure Propagation. Features shall be provided to limit propagation of stochastic fuel rod failures. These features may be inherent in the design of the fuel and blanket assemblies to eliminate or mitigate propagation or may include monitoring systems to detect pin failures in 'me to permit appropriate measures to be taken. The features provided shall be sufficient to limit propagation of each failure to the assembly in which it is located.

Justification - This criterion is unique to CRBR. The intent of this criterion is to require the design be capable of preventing fuel failure propagation which could lead to a disruption of a significant fraction of the core. Due to the design differences between CRBR and LWR fuel and to the limited experience with LMFBR fuel failures, in comparison with LWR's, especially regarding the behavior of breached fuel pin which continue to be irradiated, it is considered appropriate to require features to limit fuel failure propagation as a Principal Design Criterion. This criterion represents a new criterion from those in the PSAR which in the staff's judgment should be applied to CRBR.

Criterion 60 - Flow Blockage. The reactor internals and core assemblies shall be designed to minimize the potential for flow blockage or flow restriction to one or more core assemblies by loose parts or by core assembly loading errors sufficient to cause fuel rod failure

Justifica[illegible] This criterion is unique to CRBR. The intent of this criterion is to requ[illegible] ie reactor and core assembly design incorporate features to minimize the potential for flow blockage while the assemblies are in the reactor core such that flow blockage can be eliminated as a design basis event. With the core assemblies in CRBR being ducted assemblies, blockages or restrictions at the inlet of an assembly affect flow through the entire assembly and could cause fuel failure such as occurred in the FERMI-1 reactor. With appropriate design of the core support structure and core assembly inlet regions this potential can be greatly reduced. To eliminate flow blockage events from the CRBR design basis a criterion requiring such design features be provided is considered necessary for CRBR. This criterion represents a new criterion from those in the PSAR which in the staff's judgment should be applied to CRBR.

10 CFR 50, Appendix A, Criteria Not Included

The following criterion from 10 CFR 50, Appendix A, were not applied to CRBR. Listed below is justification as to why they were not applied.

Criterion 33 - Reactor Coolant Makeup. A system to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary shall be provided. The system safety function shall be to assure that specified acceptable fuel design lmits are not exceed as a result of reactor coolant loss due to leakage from the reactor coolant pressure boundary and rupture of small piping or other small components which are part of the boundary. The system shall be designed to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished using the piping, pumps, and valves used to maintain coolant inventory during normal reactor operation.

Justification for Exclusion - CRBR operating conditions are below the sodium saturation temperature and design provisions to ensure adequate sodium inventories are required in Principal Design Criterion 27 to ensure that a leaks do not uncover the core or stop sodium circulation and core cooling. In addition, to stop core cooling would require the loss of the entire HTS which is not considered a credible event and is not in the plant design basis. In view of the above there is no need for a separate reactor coolant makeup system and this criterion was not applied to CRBR.

Criterion 35 - Emergency Core Cooling. A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts. Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system

operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

Justification for Exclusion - In CRBR emergency core cooling is provided via reactor residual heat removal system (CRBR Criterion 35). Since under all postulated accident conditions the sodium temperature remains below the sodium saturation temperature and design criteria have been added to ensure an adequate coolant inventory and decay heat removal paths there is no need for a separate emergency core cooling system and this criterion was not applied to CRBR.

Criterion 36 - Inspection of Emergency Core Cooling System. The emergency core cooling system shall be designed to permit appropriate periodic inspection of important components, such as spray rings in the reactor pressure vessel, water injection nozzles, and piping, to assure the integrity and capability of the system.

Justification for Exclusion - Without an emergency core cooling system this criterion is not applicable.

Criterion 37 - Testing of Emergency Core Cooling System. The emergency core cooling systems hall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the system, and (3) the operability of the system as a whole and, under conditions as close to design as practical, the performance of the full operational sequence that brings the system into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system.

Justification - Without an emergency core cooling system this criterion is not applicable.

Criterion 38 - Containment Heat Removal - A system to remove heat from the reactor containment shall be provided. The system safety function shall be reduced rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.

Suitably redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

Justification for Exclusion - No postulated design basis events for CRBR cause the containment temperature to exceed its design temperature or pressure. However, CRBR may have a containment heat removal removal system and a controlled venting system to provide margin for beyond the design basis events. In view of the fact that a containment heat removal system was not required for any design basis events this criterion was not applied to CRBR.

Criterion 39, - Inspection of Containment Heat Removal System. The containment heat removal system shall be designed to permit appropriate preiodic inspection of important components, such as the torus, sumps, spray nozzels, and piping to assure the integrity and capability of the system.

Justification for Exclusion - Without a design requirement for a containment heat removal system this criterion is not applicable.

Criterion 40 - Testing of Containment Heat Removal System. The containment heat removal system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the system, and (3) the operability of the system as a whole, and under conditions as close to the design as practical the performance of the full operational sequence that brings the system into operation, including operation of

applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system.

Justification for Exclusion - Without a design requirement for a containment heat removal system this criterion is not applicable.