Accession No. ML090560022

REQUEST FOR ADDITIONAL INFORMATION

RELIEF REQUEST ISIR-28

INDIANA MICHIGAN POWER COMPANY

DONALD C. COOK NUCLEAR PLANT UNIT 1

DOCKET NO. 50-315

By letter dated October 7, 2008, Indiana Michigan Power Company submitted for Nuclear Regulatory Commission (NRC) review and approval Relief Request ISIR-28 to use weld inlays as an alternate repair technique for Alloy 82/182 dissimilar metal welds (DMW) in reactor vessel safe end-to-primary nozzles at D.C. Cook Nuclear Plant Unit 1.

While the staff regards nickel-based Alloy 52M weld material to have increased resistance to primary water stress corrosion cracking (PWSCC), the staff has not concluded that it is not susceptible to future degradation. Limited data exists that would support this conclusion. The staff is performing independent sensitivity weld inlay design calculations assuming slower crack growth rates in the Alloy 52M than in Alloy 82/182. Based on preliminary calculations, the staff is concerned about some aspects of the licensee's plans. For example, the possibility of leaving embedded flaws in the DMW and the acceptance criteria of the final surface examination of the inlay. These comments are discussed in some of the questions that follow.

To complete its review, the NRC staff requests the following additional information on the documents attached to the licensee's letter dated October 7, 2008.

1. Attachment: 10 CFR 50.55a Request: Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(i)

1-1 In Section 1.1:

(a) Clarify why the ASME Code, Section III, 1989 edition is referenced as the modification design code whereas the ASME Code, Section III, 1998 edition including addenda through 2000 is referenced as the construction code nondestructive examination. The staff's question is focused on the different sets of Section III editions that are referenced.

(b) Clarify whether or which of these codes will be used in the inlay installation.

(c) The reference of the 1998 edition of the ASME Code, Section III, is inconsistent with the applicable code of record for the third inservice inspection (ISI) interval which is the 1989 edition of the ASME Section XI. Please clarify the discrepancy.

1-2 In Section 1.2:

Provide a design drawing with dimensions of the pipe configuration being mitigated, including the reactor vessel nozzle, DMW, safe end, similar metal weld, and pipe segment. The design drawing should include the following information: the nominal diameter, thickness, and inside surface and outside surface length of each component noted in the preceding sentence; the distance between the center line of the DMW and safe end; and, actual thickness and length of the inlay.

1-3 In weld overlay relief requests, licensees have committed to submit (a) within 14 days of the weld overlay examination, the overlay examination results, and (b) prior to Mode 4, the summary of the stress analysis demonstrating that the weld overlay will provide the structural integrity of the original weld and flaw growth calculations. In Sections 2.0.b and 2.0.c of Appendix 1 to Relief Request ISIR-28, the licensee specified stress analyses and flaw growth calculations to be performed. However, the licensee has not committed to submit inlay examination and stress analysis.

The NRC requests that the licensee commit to submit (a) the inlay examination results within 14 days of completing the weld inlay examination, and (b) a summary of the stress analysis and flaw growth calculations of the DMW and inlay prior to Mode 4 and the final report within 60 days of plant restart.

1-4 In Section 7.0 of the relief request, the licensee asked for the remaining service life of the DMWs as the duration of the request. The staff notes that the ISI inspection requirements may change in the future. In addition, the staff is working generically regarding the long-term weld inlay inspection requirements. The staff is willing to consider approving the inspection portion of the request on an ISI interval basis.

Please revise the submittal accordingly.

1-5 Please discuss the inspection history of the subject DMWs, including the year of inspections, the inspection method, and results.

1-6 Please discuss whether the inlay is considered as the primary system pressure boundary (i.e., does the inlay provide structural support for the primary system loadings?)

1-7 Section 1.2, Table 2, states that the safe end cladding is made of Type 312L and Alloy 82 weld material. However, Figures 1 and 2 do not identify the Alloy 82 weld material at the safe end cladding.

Identify or describe the location of the Alloy 82 weld material at the safe end cladding in Figures 1 and 2.

2. <u>Enclosure: Weld Inlay and Potential Repair Weld Inlays for Reactor Vessel Safe End-To-Primary Nozzle Alloy 82/812 Dissimilar Metal Welds Mitigative/Repair Inlay</u>

2-1 Leak-Before-Break (LBB) Evaluation: The licensee stated that LBB remains applicable at the DMW locations.

Discuss why the "inlay" and the "repair inlay" will not affect the original LBB analysis assumptions and results.

2-2 Evaluation of Weld Shrinkage Effects:

(a) The licensee stated that weld shrinkage caused by the inlay has a negligible effect on the attached piping. Discuss the results of mockup testing and/or stress analysis that demonstrate(s) that inlay weld shrinkage has negligible effect on the attached piping.

(b) Section 2.0.d of Appendix 1 states that any changes in applied loads as a result of weld shrinkage from the inlay shall be evaluated. Discuss how weld shrinkage in the inside surface of the pipe is evaluated and how weld shrinkage is considered in the stress analysis of the pipe.

2-3 On page 4, 4th paragraph, the licensee stated that "…Analysis shows that the nozzle low alloy ferritic steel that is replaced by the Alloy 82/52M weld material does not adversely affect the structural integrity of the DMW region…"

(a) Clarify the phrase, "…the nozzle …is replaced by the Alloy 82/52M weld metal…"

(b) Describe the subject analysis and provide the results of the analysis.

2-4 (a) On page 5, second paragraph, the licensee specified that "…Following welding, acceptance/preservice PT and/or eddy current (ET) be performed thereon in accordance with NB-5000, Section III, and IWA-2222, Section XI…"

This statement needs to be clarified because it is not clear exactly which NDE will be performed using which technique per which ASME Code sections and subarticles.

(b) In Sections 3.0.c and 3.0.d of Appendix 1 to Relief Request ISIR-28, it does not appear that eddy current testing will be used to perform acceptance or preservice examination.

Clarify the discrepancy between the above statement on page 5 and Appendix 1.

(c) Discuss whether PT and ET will be performed underwater. If the surface examination is performed underwater, discuss the qualification of PT and ET for underwater examinations.

(d) If ET is used, discuss the acceptance criteria used to disposition the flaw.

(e) Discuss the qualification of welding for inlay and DMW repair underwater.

3. Enclosure: Appendix 1: Alternative Requirements for Reactor Requirements [sic] for Reactor Vessel Safe End-to-Primary Nozzle Alloy 82/182 Dissimilar Metal Weld Modification

3-1 Section 1.0.c states that the location of the DMW fusion zones shall be determined.

Please discuss how the fusion zones are determined.

3-2 Section 1.0.d states that all welding shall use Welding Procedure Specifications qualified in accordance with Appendix 2, *Ambient Temperature Temperbead Welding,* to the October 7, 2008 submittal. The staff notes that for the weld overlay design, temperbead welding is used only for the low alloy nozzle portion of the overlay installation and is not used for the welding on the piping, safe ends, or DMW.

(a) Discuss whether the ambient temperature temper bead welding is the only welding process that will be used to install the inlay on the nozzle, safe end, pipe, and DMW. If welding procedures other than the temperbead welding will be used in the inlay application, Section 1.0.d needs to be revised to specify various welding procedures (qualified to which ASME requirements) for various components.

(b) Clarify whether the ambient temperature temperbead welding will be used to repair a degraded DMW prior to the inlay installation. If temperbead welding will not be used, provide requirements for the welding process and procedures that will be used to repair the degraded DMW in Section 1.0.

3-3 Section 1.0.g requires that Alloy 52M weld metal be used for at least the final 1/8 inch thickness and more than one layer. Section 1.0.g also states that "…Alloy 82 may be used for repair welding, when applicable, beyond at least 1/8 inch, and more than one layer thickness from the inside final surface…"

(a) Clarify what is meant by "…beyond at least 1/8 inch, and more than one layer thickness from the inside final surface..."

(b) Clarify the application of Alloy 82 and Alloy 52 with respect to their thickness and location in the inlay and DMW configuration. A sketch would help to clarify the question.

3-4 (a) Section 1.0.h permits the application of a stainless steel buffer layer; however, the buffer layer is not shown in Figures 1 and 2 on page 6 of the relief request.

Reconcile Section 1.0.h and Figures 1 and 2. Also, specify the exact components that require a stainless steel buffer layer to be applied in Section 1.0.h.

(b) Figures 1 and 2 show that stainless steel cladding is located on the inside surface of the low alloy ferritic nozzle. It appears from the figures that Alloy 52M will be welded directly to the stainless steel cladding.

Discuss whether a stainless steel buffer layer will be welded to the cladding prior to welding Alloy 52M. If that is the case, Figures 1 and 2 need to be revised.

(c) Discuss the welding procedures (under which ASME requirements) that will be used to install the stainless steel buffer layer if the ambient temperature temper bead welding is not used.

(d) Discuss whether the buffer layer will be considered as part of the total inlay thickness (considered to fulfill the minimum required thickness of the inlay).

(e) Section 1.0.h states that "…it shall be permissible to apply ER309L austenitic stainless steel filler material and Alloy 82 near the DMW fusion zones, over the austenitic stainless steel material…"

Clarify this statement with a sketch and describe step by step how ER309L and Alloy 82 weld metals are deposited on the inside surface of the pipe, nozzle, safe end, and DMW.

3-5 Section 2.0.a.i requires that the minimum final inlay thickness be at least 1/8 inches.

(a) Discuss the thickness of each weld layer.

(b) Discuss the maximum allowed inlay thickness (excluding cavity repair) based on the stress analysis.

(c) Discuss the design thickness and number of the layers of the inlay (including the stainless steel buffer layer).

(d) Provide the thickness of the stainless steel buffer layer.

3-6 Section 2.0.a.iv states that the design life of the modified DMWs shall be 30 additional years. However, based on the scheduled inlay installation in October 2009, the end date of the third ISI interval of February 2010, and 20 years under the license renewal period, the inservice life of the modified DMW will exceed the design life of 30 years.

Discuss what actions will be taken if the operating life of the plant is projected to exceed the design life of the inlay.

3-7 (a) Section 2.0.c.i states that the residual stress analysis shall assume a full circumferential 50% through wall weld repair from the inside surface of the DMW.

Discuss whether the analysis for the postulated 50% through wall flaw bounds the repair of the limiting 2-inch deep flaw as permitted by Section 2.0.b.i.2.

(b) To repair a 2-inch deep flaw, discuss the maximum allowed dimension of the repair cavity in the axial and circumferential direction of the pipe without affecting residual stresses of the weld.

(c) If a flaw deeper than 2 inches in the DMW is identified, discuss the correction actions that will be taken.

(d) Are there any circumstances that the licensee is planning for in which any portion of a flaw may be left in service in the DMW? If yes, provide the technical basis.

3-8 For flaw growth analyses, Sections 2.0.c.ii.1 and 2.0.c.ii.2 specify the postulated initial flaw size (circumferential and axial flaws) in the inlay to be 1/16 inch deep.

(a) Discuss the percentage of pipe thickness of the 1/16 inch deep flaw because it is not clear whether the exact total thickness of the inlay is 1/8 inch.

(b) Discuss the allowable (acceptable) flaw size and calculated final flaw size in the inlay in terms of percentage of the pipe thickness and actual depth.

(c) If the calculated final flaw size in the inlay exceeds the allowable flaw size, discuss the corrective actions.

3-9 For flaw growth analyses, Sections 2.0.c.ii.3 and 2.0.c.ii.4 also specify the postulated circumferential and axial flaws with maximum acceptable flaw depth per IWB-3514-2, originating at the weld inlay and DMW interface and growing in the DMW.

(a) Discuss the allowable depth of the final flaw size.

(b) Discuss the flaw growth rates and degradation mechanisms that will be used in the flaw growth analyses in Section 2.0.c.ii.

(c) If the final flaw size in the DMW exceeds the allowable, discuss what corrective action will be taken.

(d) Discuss whether the postulated flaw in the inlay and the postulated flaw in the DMW are connected when performing the flaw growth analyses.

(e) Discuss whether the postulated flaws in the inlay and in the DMW are assumed to grow concurrently.

3-10 Two inlay applications were proposed: one application assumes that the DMW is not degraded and the other application assumes that the DMW is degraded. The postulated flaw size in the inlay for both applications is the same for the flaw growth analyses. However, the postulated flaws in the DMW for the flaw growth calculations are not the same for both applications. For the non-degraded DMW, the postulated flaw is 3/8 inch deep initiated from the inside surface of the pipe (as stated on page 2 of Enclosure 1). For the degraded DMW, the postulated flaw is 2 inch deep initiated from the outside surface of the DMW (as stated on page 3 of Enclosure 1). However, this difference is not reflected in Sections 2.0.c.ii.3 and 2.0.c.ii.4.

These two sections should be revised to be consistent with the description in Enclosure 1 of the October 7, 2008, letter.

3-11 Section 3.0.a.iv states that the final surface of the inlay shall be suitable for surface and volumetric examination. Many of the NRC-approved weld overlay relief requests require a surface finish of 250 micro-in (6.3 micrometers) root mean square or better and the flatness sufficient to allow for adequate examination.

Discuss why a quantitative specification for surface smoothness is not required in the inlay design.

3-12 Sections 3.0.b.i and 3.0.b.ii provide requirements for pre-inlay examinations.

(a) Discuss and provide a drawing of the required UT examination volume in term of specific axial length and volume of the DMWs, safe ends and nozzles.

(b) Discuss whether 100% coverage will be achieved on the required examination volume.

(c) Sections 3.0.b.i and 3.0.b.ii allow flaws detected in the DMW that are acceptable per IWB-3514-2 to remain in service. Provide technical basis for leaving flaws in DMWs in service because the staff has concern regarding this practice.

(d) Discuss whether the pre-inlay UT will be performed from the outside surface or inside surface of the pipe. If the UT will be performed from the inside surface of the pipe, the current UT technique cannot meet the 0.125 inch root-mean-square (RMS) error required by the ASME Code on flaw depth sizing.

Also, please clarify whether the RMS error limitation can be satisfied.

(e) If an indication(s) is detected in the DMW by the pre-inlay UT, the licensee needs to commit to notify the NRC Project Manager as soon as possible (prior to inlay installation) by telephone or electronic mails.

3-13 (a) For the acceptance and preservice examinations, Sections 3.0.c.1 and 3.0.d.i permit small rounded indications with major dimension no greater than 1/16 inch to remain inservice per ASME Section III, NB-5352. The site of these indications has the potential to initiate planar flaws. The licensee stated that planar flaws are postulated to exist in the inlay and in the original DMW. The staff is concerned that the inlay is made of only a few weld layers and a flaw with any depth may over time grow through the inlay and invalidate the basis of isolating the DMW from the primary coolant.

Provide the technical basis for the proposed acceptance criteria of the surface examination. For acceptance and preservice examinations, the staff considers penetrant test (PT) white (i.e., no indications) to be acceptable.

(b) Section 3.0.c.i states that "…Criteria for the balance of the surface examination area shall be in accordance with the inservice examination acceptance standards of Table IWB-3514-2…"

Define "the balance of the surface examination area" in Section 3.0.c.i or in Figure E1.

(c) Discuss whether an intermediate PT will be performed after each layer is deposited during inlay installation. If no intermediate PT is required, discuss the reason.

(d) Specify or reference the required examination volume and area for the acceptance examination in Section 3.0.c (such as Figure E1).

3-14 (a) Please revise Section 3.0.c.ii to state that the acceptance examination UT will be performed from the inside surface of the pipe, if this is the case.

(b) Section 3.0.c.ii states that "…Calibration standards shall be in accordance with Figure T-434.4.2.2…"

This statement should be revised to read: "…Calibration standards shall be in accordance with Figure T-434.4.2.2 as shown in Article 4 of ASME Section V…" This revision is to clarify where Figure T-434.4.2.2 is located.

3-15 For preservice examination, Section 3.0.d.ii specifies the required examination volume of the modified DMW as shown in Figure E1. The required examination includes the inner 1/3 region of the DMW. If the DMW is repaired prior to inlay installation and the repair is deeper than 1/3 thickness of the DMW, the required examination volume in Figure E1 would not cover the deep flaw repair (e.g., the repair of a 2-inch flaw) because a 2-inch flaw is more than 1/3 thickness of the hot leg or cold leg pipe thickness.

(a) In this scenario, discuss how the repaired volume in the DMW that is outside of the required inspection volume per Figure E1 can be ensured of the structural integrity.

(b) Section 3.0.d.ii should be revised to indicate that the preservice UT is performed from the inside surface of the DMW. This is to differentiate the ISI requirement in Section 3.0.e.ii which allows UT from the outside surface of the DMW.

(c) Section 3.0.d.ii states that the preservice UT is performed in accordance with Code Case N-695. The staff notes that Code Case N-695 is applicable to the inspection of DMWs using EPRI's Performance Demonstration Initiative to satisfy the ASME Code, Section XI, Appendix VIII, Supplement 10. Supplement 10 is related to the UT of DMW, not to the inlay design. Also, Code Case N-695 does not provide specifications for the inspection of inlays.

Please provide the technical basis of how Code Case N-695 can be applied to the inspection of the inlay.

3-16 In Figure E1, there are no definitions and specifications for A and B points, and ¼-inch and ½-inch lines.

(a) Clarify how points A and B are selected, and how the demarcation line for the ½ inch and ¼ inch distance is selected.

(b) Provide the basis of the ¼ inch and ½ inch distances. Section 2.0.a.ii does specify ¼ inches from the DMW fusion zones; however, it is not clear how the ¼ inch distance discussed in Section 2.0.a.ii is applicable to Figure E1.

Also, please provide the definition and explanation in Figure E1 as footnotes.

3-17 Section 3.0.e.i states that volumetric and surface examinations shall be performed on all the modified DMWs no sooner than the third refueling outage and no later than 10 years following inlay welding.

(a) Discuss the technical basis for this inspection schedule.

(b) Revise Section 3.0.e.i to clarify whether the UT and surface examination are performed from the inside surface of the DMW because Section 3.0.e.ii allows the UT to be performed from either inside surface or outside surface of the DMW.

3-18 Section 3.0.e does not appear to provide reference or definition as to the required examination volume for inservice examinations. It appears that Section 3.0.e.i should be revised to require that the examination volume in Figure E1 be followed for the inservice examinations performed from both inside diameter and outside diameter of the pipe.

Please clarify.

3-19 Section 3.0.e.ii states that 25% of the population of DMWs with no indications shall receive a volumetric examination performed from the outside diameter (OD) surface, or a volumetric examination and a surface examination performed from the weld inside diameter (ID) surface.

(a) If the preservice UT of an inlaid DMW is performed from the ID surface and the subsequent ISI UT is performed from the OD surface, the inspection results of the OD UT inspection will not be comparable to the results of the ID UT inspection.

Discuss how the UT inspection results from ID and OD surface can be compared.

(b) Clarify which ASME Code, Section XI, Appendix VIII supplement will be used to qualify the ISI UT performed from the OD surface of the pipe.

(c) An inlay thickness of 0.125 inch on a reactor vessel nozzle would be on the order of 5% of the wall thickness or less. The probability of detection for a crack of this depth in the inlay from the OD surface would be expected to be low since 10% is often viewed as the threshold of UT detection. Also, once a potential crack reaches the Alloy 82/182 weld, the weld may not be inspected (under the proposed 25% sample) or the inspection interval is long (10 years) and the crack growth rate is high.

Therefore, please discuss why a surface examination is not required for the UT performed from the weld outside surface whereas a surface examination is required for the UT performed from the weld inside surface.

3-20 Section 3.0.e.iii states that if inservice examinations reveal crack growth or new cracking meeting the acceptance standards of IWB-3132.3, the DMW examination volume shall be reexamined during the first refueling outage following discovery of the growth or new cracking. IWB-3132.3 of the1989 edition of the ASME Code, Section XI, which is the code of record, states that the component that contains a flaw shall be replaced.

Please provide the following:

(a) Clarify if this is the intent of Section 3.0.e.iii;

(b) Revise Section 3.0.e.iii to clearly define the location (in the inlay and/or DMW) of the detected new flaw or crack growth;

(c) If a new flaw is detected in the inlay, the staff's position is that that flaw should satisfy Table IWB-3410-1. A flaw that exceeds Table IWB-3410-1 should be removed.

3-21 Sections 3.0.e.ii, 3.0.e.iv, and 3.0.f discussed a sample inspection of 25% of the DMW. However, the licensee has not provided requirements for inspection expansion if an indication or flaw growth is detected in any weld in the sample inspection.

Discuss the reason why inspection expansion is not considered in the relief request.

3-22 The staff notes that ASME Code Case N-770 provides different examination frequencies for the inlay application of the non-degraded DMW and degraded DMW.

Section 3.0.e needs to state whether the ISI examination requirements for both inlay applications (i.e., the non-degraded DMW and the degraded DMW) are the same. If they are not the same, Section 3.0.e needs to be revised to specify the examination requirement for each of the applications.

3-23 (a) Provide the technical basis for the sample inspection strategy in Section 3.0.f.

(b) It was stated that those welds not included in the 25% sample shall be examined prior to the end of the evaluation period. Please define or clarify the "evaluation period".

3-24 Section 4.0 states that a system leakage test shall not be required for a weld inlay thickness of 10% or less of the original DMW thickness.

Provide the technical basis why a system leakage will not be perform if the inlay thickness is 10% or less of the original DMW thickness for the inlay configuration and for the inlay repair configuration.

3-25 The inlay design allows repair to a degraded DMW prior to inlay installation. However, the licensee did not specify NDE requirements for the DMW repair in Section 3, Examination.

Provide requirements for the NDE examinations for the case where a DMW is being repaired prior to inlay installation.

4. Enclosure: Appendix 2—Ambient Temperature Temperbead Welding

4-1 Section 1.1 states that the maximum finished surface area of the inlay over the low alloy ferritic base metal is 500 square inches. Code Case N-638-1 allows only 100 square inch area over the low alloy ferritic base metal. The NRC has approved the use of 500 square inch area over the ferritic base metal for the weld overlay installation based on the industry's finite element analysis. The staff notes that N-638-1 can be generically applied to the overlay and inlay design. However, it is not clear whether the industry's finite element model for the 500 square inch overlay area is applicable to the proposed 500 square inch weld inlay area.

Describe the stress analysis and its results that demonstrate the acceptability of the 500 square inch weld inlay area covering the inside surface of the ferritic nozzle base metal.

4-2 Section 3.3 specifies that the interpass temperature shall be determined by heat flow calculations or measurement of a test coupon.

Discuss whether the heat flow calculations and the test coupon approach have been qualified to determine accurately the interpass temperature at the inside surface of a pipe for the welding inlay underwater.