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September 7, 2011

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-11298

Subject: MHI's Responses to US-APWR DCD RAI No. 800-5879 Revision 3 (SRP 03.07.02)

Reference: 1) "Request for Additional Information No. 800-5879 Revision 3, SRP Section: 03.07.02 – Seismic Subsystem Analysis," dated 8/5/2011.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 800-5879, Revision 3."

Enclosed are the responses to 4 RAIs contained within Reference 1. Of the RAIs in Reference 1, one will not be answered within this package. It is RAI 3.7.2-90, which has a 60-day response time, as agreed to between the NRC and MHI, and will be issued at a later date by a separate transmittal.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

D081
NRO

Enclosure:

1. Responses to Request for Additional Information No. 800-5879, Revision 3

CC: J. A. Ciocco
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Docket No. 52-021
MHI Ref: UAP-HF-11298

Enclosure 1

UAP-HF-11298
Docket No. 52-021

Responses to Request for Additional Information No. 800-5879,
Revision 3

September, 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/7/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 800-5879 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**8/5/2011**

QUESTION NO. RAI 03.07.02-86:

In MUAP-10024 (R0), Section 1.0 "Introduction" (page 2) the second paragraph states "As a nuclear NS structure, the AC/B is not required to satisfy the requirements of 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants." Instead, the AC/B is designed to meet the seismic requirements of the International Building Code (IBC) (Reference 7-2). This document summarizes the requirements for the stress analyses and sizing of the building structure to satisfy the requirements of the DCD (Reference 7-1)."

The reference to US-APWR DCD requirements is non-specific. In order for the staff to evaluate the report and its conclusions, the staff needs to know the specific design requirements that govern the design of the access building (AC/B). The Applicant is, therefore, requested to provide the staff with the specific requirements stated in the USAPWR DCD that are to be satisfied.

ANSWER:

As stated in Tier 2 DCD Subsection 1.2.1.7.1 and Table 3.2-4 of Subsection 3.2.1.3, the access control building (AC/B) is listed with the buildings and structures comprising the main US-APWR power block and is a non-seismic structure and has a seismic classification of Non-Seismic (NS). Also as stated in DCD Subsection 3.2.1.1.3, the NS AC/B has no safety-related functions or nuclear safety design requirements. The specific requirements in the DCD for building structures are primarily contained in Sections 3.7 and 3.8, which are applicable for seismic Category I and seismic Category II building structures and therefore not applicable to the AC/B. The general, primary DCD requirements for a non safety-related and non-seismic structure such as the AC/B are that it is designed and constructed such that in the unlikely event of a failure, it will not jeopardize or impact the functions of safety-related or seismic Category I structures, systems and components (SSCs) or cause an adverse impact or interaction with seismic Category I SSCs.

NS structures such as the AC/B are designed and constructed to the applicable standard building code requirements, industry codes and standards as stated in DCD Subsection 3.2.1.1.3. The AC/B is mainly a reinforced concrete building meeting the structural design and analysis requirements of the ACI 318-08, and meeting the seismic requirements of the International Building Code (IBC) as stated in DCD Subsection 3.7.2.8.1. Structural steel components used in the design meet the requirements of ANSI/AISC 360-05. See MUAP-10024 Subsection 2.3 for

governing codes and design standards, and Subsection 2.4 for structural acceptance criteria applicable to the AC/B.

The last sentence of the second paragraph in Section 1.0 of MUAP-10024 will be revised to read as follows:

> "This document summarizes the requirements for the stress analyses and sizing of the building structure to satisfy the requirements of Section 3.2.1.1.3 of the DCD (Reference 7-1)."

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

See the Attachment 3 mark-up of MUAP-10024 Section 4.2, changes to be incorporated.

The last sentence of the second paragraph is revised to read as follows:

> "This document summarizes the requirements for the stress analyses and sizing of the building structure to satisfy the requirements of Section 3.2.1.1.3 of the DCD (Reference 7-1)."

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/7/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 800-5879 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**8/5/2011**

QUESTION NO. RAI 03.07.02-87:

In, MUAP 10024 (R0), subsection 4.1, "General Description", the 4th paragraph (page 9) states "Refer to Figures 1-1 through 1-7 for a general layout of the AC/B. The west wall of the AC/B is adjacent to a portion of the east wall of the auxiliary building (A/B). The AC/B and adjoining A/B, including basemats, are structurally separated by a seismic gap of at least 4 inches at and below the grade."

It is not clear to the staff from the report as to how the adequacy of the 4 inch gap is evaluated for the AC/B to demonstrate that this gap is sufficient to avoid collision of the AC/B foundation with the foundations of adjacent buildings. The Applicant is requested to describe the analyses performed and provide the numerical results of such analyses.

ANSWER:

MUAP 10024 (R0), which is the design criteria in the context of nuclear safety for the Access Building (AC/B), does not require evaluation of the gap between the AC/B and the A/B to demonstrate that this gap is sufficient to avoid collision during an SSE. Only the gaps located between seismic Category I buildings and their adjoining buildings must be evaluated per Subsections 3.7.2.8 and 3.8.4.1 of DCD (R3). The AC/B is not adjoining to any seismic category I structure. The AC/B consists of five floors, two of which are below grade and is structurally designed as a non safety-related, non-seismic structure on reinforced concrete foundation located adjacent to the west side of the taller and wider seismic Category II Auxiliary Building (A/B) which separates it from the other seismic Category I buildings. Therefore, it was not necessary to perform gap analyses due to an SSE and its accompanying calculations with numerical results.

In accordance with MUAP 10024 (R0), Section 2.4, "The deflections of the structural members are limited to the maximum values as specified in ACI 318 and AISC 360."

The AC/B is not required by either the IBC or the DCD Table 3.2-4 of Subsection 3.2.1.3 and Subsection 3.3.2.3 to be designed for an SSE earthquake or tornado effects and consequently it could potentially fail were it to be subjected to these seismic category I design basis loadings.

Since its location is sufficiently far away from seismic Category I structures, and adjacent safety-related SSCs buried in the plant yard, the collapse of the AC/B would not have a direct fall path to impact any safety-related, seismic Category I SSCs due to the presence of the intervening A/B. The AC/B may also have localized failure due to tornado loading; however, the design precludes the generation of missiles that are not bounded by the design basis spectrum of tornado missiles as described in DCD Subsection 3.5.1.4.

Per MUAP 10024 (R0), Section 6.1, "If the AC/B were to fail or collapse, it could only impact the A/B which is a seismic Category II structure. The AC/B is smaller, shorter, and much less massive than the reinforced concrete A/B. In the unlikely event of impact, there would not be sufficient kinetic energy transfer to cause the A/B to displace beyond acceptable limits. Specifically, the A/B would not displace enough to impact the reactor building (R/B), PS/Bs, or any other seismic Category I SSCs."

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on a Technical/Topical Report.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/7/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 800-5879 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**8/5/2011**

QUESTION NO. RAI 03.07.02-88:

In MUAP 10024 (R0), subsection 4.2 "Structural Geometry", the 4th sentence in the 3rd paragraph (page 9) states "The locations of any safety-related SSCs in the plant yard adjacent to the AC/B, including those which may be field routed, are reviewed prior to installation to ensure that their distances away from the AC/B and/or burial depths are sufficient to prevent potential failure effects that could jeopardize their function and integrity."

The staff is unable to find any specific COL action item that requires a review of the location of safety-related SSCs in the plant yard in relation to the AC/B. COL 3.7 (9) in the US-APWR DCD (R3) addresses the location of seismic Category I SSCs with respect to seismic loadings, but there are no action items in the DCD addressing the effects of tornado missiles or other effects of failure of the AC/B on the integrity of safety-related SSCs. The Applicant is requested to include a COL action item that assures the appropriate location of any safety-related SSCs in the plant yard.

ANSWER:

Because it is a non-safety related, non-seismic structure, the failure of the Access Building (AC/B) is postulated due to either design-basis tornado or safe-shutdown earthquake (SSE) loading as described in DCD Subsections 3.3.2.3 and 3.7.2.8.1. DCD COL item 3.7(9) requires the COL Applicant "to assure that the design or location of any site-specific seismic category I SSCs, for example pipe tunnels or duct banks, will not expose those SSCs to possible impact due to the failure or collapse of non-seismic category I structures, or with any other SSCs that could potentially impact, such as heavy haul route loads, transmission towers, non safety-related storage tanks, etc." DCD COL item 3.7(9) provides assurance that safety-related SSCs are not jeopardized by the failure or collapse of the AC/B, whether such a failure or collapse is caused by tornado or seismic loading. Therefore no additional COL action item is required to assure the appropriate location of any safety-related SSCs in the plant yard.

DCD COL item 3.7(9) uses the term "site-specific seismic category I SSCs". This term will be revised to "site-specific safety-related SSCs" to align with the broader terminology used in the discussion in DCD Subsection 3.3.2.2 and MUAP-10024 Section 4.2. The first sentence in the third paragraph of MUAP-10024 Section 4.2 will be clarified below to state: "The AC/B is not required by either the IBC or the DCD to be designed for design-basis tornado effects or SSE loading, and consequently it could potentially fail." The last sentence in the third paragraph of

MUAP-10024 Section 4.2 will be clarified below to state: "Therefore, the ability of other SSCs to perform their intended safety functions is not affected by the potential collapse or localized failure of the AC/B."

Impact on DCD

See the Attachment 1 mark-up of DCD Tier 2, Subsection 3.7, changes to be incorporated.

DCD COL item 3.7(9) is revised to read as follows:

> "The COL Applicant is to assure that the design or location of any site-specific safety-related SSCs, for example pipe tunnels or duct banks, will not expose those SSCs to possible impact due to the failure or collapse of non-seismic category I structures, or with any other SSCs that could potentially impact, such as heavy haul route loads, transmission towers, non safety-related storage tanks, etc."

See the Attachment 2 mark-up of DCD Tier 2 Table 1.8-2 (Sheet 5), changes to be incorporated.

DCD COL item 3.7(9) is revised to read as follows:

> "The COL Applicant is to assure that the design or location of any site-specific safety-related SSCs, for example pipe tunnels or duct banks, will not expose those SSCs to possible impact due to the failure or collapse of non-seismic category I structures, or with any other SSCs that could potentially impact, such as heavy haul route loads, transmission towers, non safety-related storage tanks, etc."

Impact on R-COLA

The text changes described above for the DCD will also be implemented in the R-COLA.

Impact on S-COLA

The text changes described above for the DCD will also be implemented in the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

See the Attachment 3 mark-up of MUAP-10024 Section 4.2, changes to be incorporated.

The first sentence in the third paragraph is revised to read as follows:

> "The AC/B is not required by either the IBC or the DCD to be designed for design-basis tornado effects or SSE loading, and consequently it could potentially fail."

The last sentence in the third paragraph is revised to read as follows:

> "Therefore, the ability of other SSCs to perform their intended safety functions is not affected by the potential collapse or localized failure of the AC/B."

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

9/7/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 800-5879 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**8/5/2011**

QUESTION NO. RAI 03.07.02-89

In MUAP 10024 (R0), subsection 5.2, "Reinforcement" (page 10) states "Concrete reinforcement shall be deformed bars conforming to ASTM A 615, Grade 60, or ASTM A 706, Grade 60. These bars possess the properties given in Table 5-2. Reinforcement splices shall comply with ACI 318, Chapter 12 (Reference 7-3). Welding of reinforcing steel is not anticipated, however is to be performed in accordance with American Welding Society (AWS) D1.4 (Reference 7-13) if applicable."

The last sentence in the above quoted paragraph is confusing. It states that welding of rebar splices is not anticipated, but if welding is done it must meet the specified AWS code. It is not clear whether or under what conditions welding of the splices would be performed. The Applicant is requested to provide information that shows under what circumstances welded rebar splices are used, and why welding is necessary.

ANSWER:

It is MHI's preference to minimize the use of welded reinforcing steel, i.e. rebar splices. The use of welded rebar splices may be necessary under, but is not limited to, the following conditions:

1. Reduce rebar congestion and improve concrete consolidation
2. To meet minimum concrete cover per the ACI Code
3. Where use of lap splice is prohibited by the ACI Code on rebar sizes larger than No. 11

The last sentence in the referenced Section 5.2 of MUAP-10024 will be clarified to read as follows:

"Welding of reinforcing steel is minimized, however, if used, shall be performed in accordance with American Welding Society (AWS) D1.4 (Reference 7-13)."

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

See the Attachment 3 mark-up of MUAP-10024 Section 5.2, changes to be incorporated.

The last sentence of subsection 5.2 is revised to read as follows:

> "Welding of reinforcing steel is minimized, however, if used, shall be performed in accordance with American Welding Society (AWS) D1.4 (Reference 7-13)."

COL3.7(6) *The COL Applicant is to develop site-specific GMRS and FIRS by an analysis methodology, which accounts for the upward propagation of the GMRS. The FIRS are compared to the CSDRS to assure that the US-APWR standard plant seismic design is valid for a particular site. If the FIRS are not enveloped by the CSDRS, the US-APWR standard plant seismic design is modified as part of the COLA in order to validate the US-APWR for installation at that site.*

COL3.7(7) *The COL Applicant is to determine the allowable static and dynamic bearing capacities based on site conditions, including the properties of fill concrete placed to provide a level surface for the bottom of foundation elevations, and to evaluate the bearing loads to these capacities.*

COL3.7(8) *The COL Applicant is to evaluate the strain-dependent variation of the material dynamic properties for site materials.*

COL3.7(9) *The COL Applicant is to assure that the design or location of any site-specific ~~seismic category I~~safety-related SSCs, for example pipe tunnels or duct banks, will not expose those SSCs to possible impact due to the failure or collapse of non-seismic category I structures, or with any other SSCs that could potentially impact, such as heavy haul route loads, transmission towers, non safety-related storage tanks, etc.* DCD_03.07.02-88

COL3.7(10) *It is the responsibility of the COL Applicant to further address structure-to-structure interaction if the specific site conditions can be important for the seismic response of particular US-APWR seismic category I structures, or may result in exceedance of assumed pressure distributions used for the US-APWR standard plant design.*

COL3.7(11) *Deleted*

COL3.7(12) *It is the responsibility of the COL Applicant to design seismic category I below- or above-ground liquid-retaining metal tanks such that they are enclosed by a tornado missile protecting concrete vault or wall, in order to confine the emergency gas turbine fuel supply.*

COL3.7(13) *The COL Applicant is to set the value of the OBE that serves as the basis for defining the criteria for shutdown of the plant, according to the site specific conditions.*

COL3.7(14) *The COL Applicant is to determine from the site-specific geological and seismological conditions if multiple US-APWR units at a site will have essentially the same seismic response, and based on that determination, choose if more than one unit is provided with seismic instrumentation at a multiple-unit site.*

COL3.7(15) *Deleted*

Table 1.8-2 Compilation of All Combined License Applicant Items for Chapters 1-19 (Sheet 5 of 34)

COL ITEM NO.	COL ITEM
COL 3.7(3)	*It is the responsibility of the COL Applicant to develop analytical models appropriate for the seismic analysis of buildings and structures that are designed on a site-specific basis including, but not limited to, the following:* • *PSFSVs (seismic category I)* • *ESWPT (seismic category I)* • *UHSRS (seismic category I)*
COL 3.7(4)	*To prevent non-conservative results, the COL Applicant is to review the resulting level of seismic response and determine appropriate damping values for the site-specific calculations of ISRS that serve as input for the seismic analysis of seismic category I and seismic category II subsystems.*
COL 3.7(5)	*The COL Applicant is to assure that the horizontal FIRS defining the site-specific SSE ground motion at the bottom of seismic category I or II basemats envelope the minimum response spectra required by 10 CFR 50, Appendix S, and the site-specific response spectra obtained from the response analysis.*
COL 3.7(6)	*The COL Applicant is to develop site-specific GMRS and FIRS by an analysis methodology, which accounts for the upward propagation of the GMRS. The FIRS are compared to the CSDRS to assure that the US-APWR standard plant seismic design is valid for a particular site. If the FIRS are not enveloped by the CSDRS, the US-APWR standard plant seismic design is modified as part of the COLA in order to validate the US-APWR for installation at that site.*
COL 3.7(7)	*The COL Applicant is to determine the allowable static and dynamic bearing capacities based on site conditions, including the properties of fill concrete placed to provide a level surface for the bottom of foundation elevations, and to evaluate the bearing loads to these capacities.*
COL 3.7(8)	*The COL Applicant is to evaluate the strain-dependent variation of the material dynamic properties for site materials.*
COL 3.7(9)	*The COL Applicant is to assure that the design or location of any site-specific ~~seismic category I~~safety-related SSCs, for example pipe tunnels or duct banks, will not expose those SSCs to possible impact due to the failure or collapse of non-seismic category I structures, or with any other SSCs that could potentially impact, such as heavy haul route loads, transmission towers, non safety-related storage tanks, etc.*
COL 3.7(10)	*It is the responsibility of the COL Applicant to further address structure-to-structure interaction if the specific site conditions can be important for the seismic response of particular US-APWR seismic category I structures, or may result in exceedance of assumed pressure distributions used for the US-APWR standard plant design.*
COL 3.7(11)	*Deleted*

DCD_03.07.02-88

1.0 INTRODUCTION

This design criteria provides the structural design criteria for the access control building (AC/B) for the US-APWR. This standard design is performed in support of the submittal to the Nuclear Regulatory Commission (NRC) of US-APWR Design Control Document (DCD) (Reference 7-1). The AC/B is one of the structures comprising the standard plant structures, but is non-seismic (NS) category and non-safety related category construction.

As a nuclear NS structure, the AC/B is not required to satisfy the requirements of 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants." Instead, the AC/B is designed to meet the seismic requirements of the International Building Code (IBC) (Reference 7-2). This document summarizes the requirements for the stress analyses and sizing of the building structure to satisfy the requirements of the DCD (Reference 7-1). DCD_03.07.02-86

of Section 3.2.1.1.3

4.0 BUILDING DESCRIPTION

4.1 General Description

The AC/B is a separate building that houses the equipment and control facilities associated with the entry of personnel into the Auxiliary Building (AB). The health physics facilities are located within a radiological controlled area (RCA) within the AC/B. Access to the AB is normally through the entry/exit area of the RCA of the AC/B. The health physics facility consists of hot laboratories, personnel and equipment decontamination areas, radiation monitoring areas, a count room, a protective clothing dressing room, and a stairway. The health physics facility is isolated from the rest of the AC/B by interior concrete walls, which form the boundaries of the RCA.

The other main function of the AC/B is to house the TSC that is used in the event of an emergency.

The equipment located in the AC/B is classified as non-safety, and non-seismic.

Refer to Figures 1-1 through 1-7 for a general layout of the AC/B. The west wall of the AC/B is adjacent to a portion of the east wall of the auxiliary building (A/B). The AC/B and adjoining A/B, including basemats, are structurally separated by ~~a seismic gap of at~~ least 4 inches at and below the grade.

or SSE loading,

4.2 Structural Geometry

design-basis

The AC/B is a rectangular building having a footprint of 165'- 0" x 56'-0". The elevation of the roof at the TSC is 48'-2". It consists of five floors, two of which are below grade.

The AC/B is a low-rise, simple rigid diaphragm building which conforms to the requirements of ASCE/SEI 7-05 Subsections 6.4.1.1 and 6.4.1.2 (Reference 7-5). Therefore, the AC/B is analyzed for design wind loads using method 1 of ASCE/SEI 7-05 (Reference 7-5). Reinforced concrete shearwalls serve as the main lateral force resisting system. In some areas, interior steel frames will provide support for the floors or roofs. The floors and roof will be cast-in-place concrete diaphragms using steel deck as formwork.

The AC/B is not required by either the IBC or the DCD to be designed for tornado effects and consequently it could potentially fail ~~due to design basis tornado loading~~. However, since its location is sufficiently far away from seismic category I structures, and adjacent safety-related SSCs buried in the plant yard, the collapse of the AC/B would not impact any adjacent safety-related SSCs. The AC/B may also have localized failure due to tornado loading; however, the design precludes the generation of missiles that are not bounded by DCD Subsection 3.5.1.4 (Reference 7-1). The locations of any safety-related SSCs in the plant yard adjacent to the AC/B, including those which may be field routed, are reviewed prior to installation to ensure that their distances away from the AC/B and/or burial depths are sufficient to prevent potential failure effects that could jeopardize their function and integrity. Therefore, the ability of other SSCs to perform their intended safety functions is not affected by the potential collapse or localized failure of the AC/B ~~due to tornado loading~~.

DCD_03.07.02-88

DCD_03.07.02-88

5.0 STRUCTURAL MATERIAL REQUIREMENTS

5.1 Concrete

Concrete utilized in the AC/B will have the properties shown in Table 5-1.

5.2 Reinforcement

minimized

Concrete reinforcement shall be deformed bars conforming to ASTM A 615, Grade 60, or ASTM A 706, Grade 60. These bars possess the properties given in Table 5-2. Reinforcement splices shall comply with ACI 318, Chapter 12 (Reference 7-3). Welding of reinforcing steel is ~~not anticipated~~, however ~~is to~~ be performed in accordance with American Welding Society (AWS) D1.4 (Reference 7-13) ~~if applicable~~.

DCD_03.07.02-89

, if used, shall

5.3 Structural Steel

Material properties and requirements for any structural steel components utilized in the design of the structure shall be in accordance with the following standards:

- Structural Steel: ASTM A36 (F_y = 36 ksi) or A992 (F_y = 50 ksi)
- High strength bolts: ASTM A325 or A490
- Anchor bolts (rods): ASTM A307 or F1554
- Steel floor decking: ASTM A446 with minimum F_y = 33 ksi
- Studs: ASTM A 108