

AUDIT WORKSHEET
GALL REPORT AMP

PLANT: _____

LRA AMP: _____

GALL AMP: **XI.E4, Metal Enclosed Bus**

REVIEWER: _____

DATE: _____

Program Element	Auditable GALL Criteria	Documentation of Audit Finding
Program Description	<p>A. Metal enclosed buses (MEBs) are electrical buses installed on electrically insulated supports and are constructed with each phase conductor enclosed in a separate metal enclosure or all conductors enclosed in a common metal enclosure (non-segregated bus). The conductors are adequately separated and insulated from ground by insulating supports. Also, the conductors in the non-segregated bus are insulated throughout the conductor length to reduce corona and electrical tracking. The MEBs are used in power systems to connect various elements in electric power circuits such as switchgear, transformers, main generator, and diesel generators.</p>	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	<p>B. Industry operating experience indicates that failures of MEBs have been caused by cracked insulation and moisture or debris buildup internal to the bus duct housing. Failures of MEB's have been attributed to the cracking of bus bar insulation (bus sleeving), combined with the accumulation of moisture or debris in the bus bar enclosure. Cracked insulation has resulted from high ambient temperature and contamination from bus bar joint compound. Cracked insulation in the presence of moisture or debris has provided phase-to-phase or phase-to-ground electrical tracking paths, which has resulted in catastrophic failure of the buses. Bus failure has led to loss of power to electrical loads connected to the buses, causing subsequent reactor trips, and initiating unnecessary challenges to plant</p>	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:</p> <p>Comment:</p>

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	systems.	
“	C. Buses in MEBs may experience loosening of bolted connections resulting from the repeated cycling of connected loads. This phenomenon can occur in heavily loaded circuits (i.e., those exposed to appreciable ohmic heating). SAND 96-0344 identified instances of termination loosening at several plants due to thermal cycling and NRC Information Notice 2000-14 identified torque relaxation of splice plate connecting bolts as one potential cause of a MEB fault.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
“	D. The purpose of the aging management program is to provide an inspection of MEBs. In this aging management program, bolted connections at sample sections of the buses in the MEBs will be checked for loose connection. This activity also includes internal visual inspection of the MEBs to identify age related degradation of insulating and metallic components and moisture/debris intrusion.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
1. Scope of Program	A. This program applies to MEBs within the scope of license renewal.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment
2. Preventive Actions	A. This is an inspection program and no actions are taken as part of this program to prevent or mitigate aging degradation.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:

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3. Parameters Monitored/ Inspected	A. A sample of accessible bolted connections will be checked for loose connection.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	B. Alternatively, bolted connections covered with heat shrink tape, sleeving, insulating boots, etc., may be visually inspected for insulation material surface anomalies.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	C. This program provides for the inspection of the internal portion of the MEBs for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	D. The bus insulation will be inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	E. The internal bus supports will be inspected for structural integrity and signs of cracks.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>

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4. Detection of Aging Effects	A. A sample of accessible bolted connections will be checked for loose connection by using thermography or by measuring connection resistance using a low range ohmmeter.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	B. MEB internal surfaces will be visually inspected for aging degradation of insulating material and for foreign debris and excessive dust buildup, and evidence of moisture intrusion.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	C. Bus insulation will be visually inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	D. Internal bus supports will be visually inspected for structural integrity and signs of cracks.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>
“	E. This program will be completed before the period of extended operation and every 10 years thereafter provided visual inspection is not used to check bolted connections. A 10 year inspection interval will provide two data points during a 20-year period, which can be used to characterize the degradation rate. This is an adequate period to preclude failures of the MEBs since experience has shown that aging degradation is a slow process.	<p>Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Document(s) used to confirm Criteria:</p> <p>Comment:</p>

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“	F. As an alternative to thermography or measuring connection resistance of bolted connections, for the accessible bolted connections that are covered with heat shrink tape, sleeving, insulating boots, etc., the applicant may use visual inspection of insulation material to detect surface anomalies, such as discoloration, cracking, chipping or surface contamination. When this alternative visual inspection is used to check bolted connections, the first inspection will be completed before the period of extended operation and every five years, thereafter.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
5. Monitoring and Trending	A. Trending actions are not included as part of this program because the ability to trend inspection results is limited. However, results that are trendable provide additional information on the rate of degradation.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
6. Acceptance Criteria	A. Bolted connections needed to be below the maximum allowed temperature for the application when thermography is used or a low resistance value appropriate for the application when resistance measurement is used.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
“	B. MEBs are to be free from unacceptable visual indications of surface anomalies, which suggest that conductor insulation degradation exists.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
“	C. In addition no unacceptable indication of corrosion, cracks, foreign debris, excessive dust buildup or evidence of moisture intrusion is to exist. An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of intended function.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:

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“	D. When the visual inspection alternative for bolted connections is used, the absence of discoloration, cracking, chipping or surface contamination will provide positive indication that the bolted connections are not loose.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
7. Corrective Actions	A. Further investigation and evaluation are performed when the acceptance criteria are not met. Corrective actions may include but are not limited to cleaning, drying, increased inspection frequency, replacement, or repair of the affected MEB components.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
“	B. If an unacceptable condition or situation is identified, a determination is made as to whether the same condition or situation is applicable to other accessible or inaccessible MEBs. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
8. Confirmation Process	A. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
9. Administrative Controls	A. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the administrative controls.	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria: Comment:
10. Operating Experience	A. Industry experience has shown that failures have occurred on MEBs caused by cracked insulation and moisture or debris buildup internal to the MEB. Experience has also shown that bus connections in the MEBs exposed to appreciable ohmic	Consistent with GALL AMP: <input type="checkbox"/> Yes <input type="checkbox"/> No Document(s) used to confirm Criteria:

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	heating during operation may experience loosening due to repeated cycling of connected loads.	Comment:

EXCEPTIONS

Item Number	Program Elements	LRA Exception Description	Basis for Accepting Exception	Documents Reviewed (Identifier, Para.# and/or Page #)
1.				
2.				
...				

ENHANCEMENTS

Item Number	Program Elements	LRA Enhancement Description	Basis for Accepting Enhancement	Documents Reviewed (Identifier, Para.# and/or Page #)
1.				
2.				
...				

DOCUMENT REVIEWED DURING AUDIT

Document Number	Identifier (number)	Title	Revision and/or Date
1.			
2.			
3.			
4.			
....			