APPENDIX F

STANDARD OPERATING PROCEDURES (CD)

THIS PAGE INTENTIONALLY LEFT BLANK

LEVEL 2 WARN

HEALTH AND SAFETY PLAN

GMS Project # 0275655.2

This Level 2 Work Activity Risk Assessment (WARN) Health & Safety Plan (HASP) is intended to provide health and safety guidelines for project field work meeting ONE OR MORE OF the following criteria:

- **Some likelihood of physical and/or chemical hazard exposure (e.g., sampling)**
- **Number of job tasks is five or greater**
- **Use of subcontractors**
- **Fieldwork is being performed on an active or abandoned mining site**
- **"High-hazard" work to be performed, including but not limited to:**
  - **Excavations and trenching**
  - **Confined Spaces**
  - **Hot Work**
  - **Subsurface Clearance *(must complete and attach Subsurface Clearance Project Plan)***
  - **Hazardous Energy Control Operations**
  - **Work at heights**
  - **Overhead Utilities/Proximity Hazards**
  - **Lifting Operations**
  - **Construction**
  - **Decommissioning, Decontamination and Demolition (DDD) Operations**
  - **Injection Well Operations**

If NONE of the above applies, an e-mail or Level 1 HASP template may be used. For more complex sites with significant client health and safety requirements, the project team may consider use of a long-form Level 3 WARN HASP.

This HASP should be developed with input from the project team, and reviewed with all ERM project personnel (including subcontractors). A signed copy of the HASP must be maintained at the project site during work and in the project files.

H&S Team review is required for the Level 2 WARN HASP. This HASP must be reviewed by the Project Manager and Partner-in-Charge (PIC) and updated as warranted to address changes in scope, hazards present, project personnel, etc. At a minimum, HASPs must be reviewed annually or if the scope of work changes. Updated HASPs should also be sent to the H&S Team and PIC for approval.

Administrative Information			
This document has been developed for the sole use of ERM staff. Subcontractors and other project participants must develop their own HASP. **This document is valid for a maximum time period of one year after initial completion. This document must be reviewed if the scope of work or nature of site hazards changes and updated as warranted.** **All on-site personnel must be appropriately trained and qualified for the planned scope of work to be performed.**	Site Name and Location Paducah Plant C-400 SE; 761 Veterans Ave., Kevil, KY 42053 Area		
	Client Contact and Phone: Jeff Seaton, 270-816-4106		
	Project Name C-400 Interim Remedial Action Phase IIB Steam Injection Treatability Study		
	Health & Safety Plan Date 12/27/2014	Revision Number and Date V3, 1/5/15	
	Field Work Start Date 01/12/2015	Anticipated Field Work End Date 08/31/2015	
	Project Manager (*responsible for implementing the site health and safety program on this project*) Jay Dablow	Partner In Charge (*responsible for overall site health and safety performance on this project).* Mark Bradford	
	Field Safety Officer (*responsible for all health & safety activities, recordkeeping and delegation of duties to any other project team members*) Charlotte Dorrity, CSP Davis Duncan, CIH	Additional ERM personnel on site: Roberts, Andrew – Field Geologist Regan, Catherine – Field Engineer Dorrity, Charlotte – site Safety Duncan, Dave – Site Safety Moss, Geof – QA Manager	Dablow, Jay – Proj Mgr, Site Supe (Ops); field QA/QC Mgr Rogers, Jonathan – Field Geologist Thornhill, Liz – Site Safety
H&S Team Review	Review Date 1-6-15	Signature	

Site Setting	
Include relevant background information regarding the site, such as location, size, type of facility, topography, weather, infrastructure, security, previous site use, etc. Describe nature and extent of any soil/air/water/groundwater contamination. **Describe any other aspects of the site that may potentially affect the health, safety, or security of on-site personnel.**	Site: The DOE and its predecessor, the AEC, performed uranium enrichment at PGDP from 1952 until 1993, at which point uranium enrichment operational responsibility was transferred to the United States Enrichment Corporation (USEC). USEC leased real property, facilities and infrastructure from DOE to continue enrichment operations. Enrichment operations were conducted by USEC from 1993 until May of 2013. The Paducah Gaseous Diffusion Plant (PGDP) is located approximately 10 miles west of Paducah, Kentucky, and 3.5 miles south of the Ohio River in the western part of McCracken County. The plant is located on a DOE-owned site; approximately 650 acres are within a fenced security area. Approximately 800 acres are located outside the security fence, and the remaining 1,986 acres are licensed to the Commonwealth of Kentucky (the West Kentucky Wildlife Management Area). Enrichment operations resulted in the release of trichloroethene (TCE), a chlorinated volatile organic compound, into the environment at PGDP. At the C-400 Cleaning Building area TCE is present in the subsurface as a dense non-aqueous phase liquid(DNAPL) and has resulted in the contamination of groundwater.

Project Background and Scope of Work **Include list of tasks to be completed by ERM personnel during this project, and a separate list of tasks to be completed by any subcontractors at the site.** **A site-specific Job Hazard Analysis (JHA) must be completed for each task to be performed. Subcontractors must provide their own HASP. Subcontractors must provide JHAs for each task they will perform for ERM review.** **JHA template and reference/example JHAs for more common tasks can be found at:** **Americas H&S Page - JHAs**	ERM Scope of Work: ERM will provide the appropriate technology, contractor management, site oversight, and safety oversight for the project, including mobilization, construction, drilling, injection and testing, and demobilization. Reference Exhibit "D", Scope of Work for Installation and Operations of the C-400 Interim Remedial Action Phase IIb Steam Injection Treatability Study (7/31/14). Subcontractor(s) Scope of Work: Subcontractors to ERM will be providing drilling, construction, mobilization and demobilization services in accordance with the aforementioned Exhibit.

Subcontractor(s) to be used:	Has subcontractor been approved (PICS or other local approval)?	
McMillan McGee USA, Inc	☐ Y	☒ N
Falta Environmental	☐ Y	☒ N
Cascade Drilling	☒ Y	☐ N
Murtco, Inc	☐ Y	☒ N
Lattner Boiler Manufacturer	☐ Y	☒ N

Site/Project General Information *** Complete and attach the appropriate Risk Assessment checklist.**	**Site Type (check all applicable boxes)** ☐ Remote Site* ☐ Inactive Facility* ☒ Hazardous waste release site (HAZWOPER) ☐ Railroad ☐ Industrial ☐ Residential ☐ Unsecured ☐ Coastal / Offshore (on or near water) ☒ Other (specify) DOE Uranium Enrichment Facility

Safe Work Practices	Main Site Hazards (check all applicable boxes)			
Place a checkmark by applicable site hazards. **Adequate control measures for all checked hazards must be included in site-specific JHAs, which should be attached to the HASP** **** High hazard work requiring H&S team coordination (additional control measures required beyond JHA)** ***** Permit-required high hazard work, requiring safety team coordination and ERM or equivalent client-required permit to be completed** **More detailed guidance on specific safety topics can be found in the Health & Safety Guidance Documents Section on the Americas Safety Page on Minerva.**	☐ Natural Hazards (Plants, Insects Animals)	☒ Organic Chemicals	☐ Inorganic Chemicals	☐ Material Handling Equipment in Use*
	☐ Journey Management	☒ Overexertion / Fatigue	☐ Line Breaking***	☐ Extended Shifts (>14 hrs + driving)
	☐ Compressed Gas	☐ Asbestos	☒ High Noise (>85 dBA)	☐ Respirable Particles
	☐ Work at Heights > feet (1.2 m)**	☒ Extreme Weather	☒ Hand/Portable Power Tools	☐ Non-Ionizing Radiation
	☐ Use of Blasting Materials or Explosives**	☐ Confined Space Entry***	☐ ASTs/USTs	☒ Buried/Overhead Utilities and Subsurface Clearance***
	☒ Slip/Trip/Fall	☒ Forklift and Industrial Truck Use**	☐ Scissor Lift / Cherry Picker Use*	☒ Ergonomics / Manual Lifting
	☐ Scaffold Use	☐ Portable Ladders	☐ Welding or Hot Work***	☒ Construction**
	☒ Excavations and Trenching***	☐ All-Terrain Vehicle	☐ Helicopter Transportation	☐ Surface/Underground Mines
	☐ Control of Hazardous Energy***	☐ Working on or over water	☐ Working in or near surface waters (lakes/rivers)	☐ Underwater Diving**
	☒ Hazard Communication	☒ Medical Services and First Aid	☒ Airborne Contaminants	☐ Critical Lifting***
	☐ Chemical mixing and injection	☐ Unexploded Ordinance / Munitions and Explosives of Concern (UXO/MEC)**	☒ Personal Protective Equipment (PPE)	☒ Respiratory Protection
	☐ Travel to Medium/High Risk Locations**	☒ Drum Handling	☐ Protection by Armed Security Forces**	☐ Non-Standard Shifts (e.g., night work)
	☒ **Other (specify)** Ionizing radiation		☐ **Other(specify)**	☐ **Other(specify)**

Chemical Products Used or Stored Onsite	
For each chemical product identified, a Safety Data Sheet (SDS) or Chemical Safety Data Card (CSDC) must be attached to this HASP. **SDS/CSDS for many common chemicals may be found on the Americas Safety Page on Minerva.**	☐ Alconox or Liquinox* ☒ Hydrochloric acid (HCl)* ☒ Nitric acid (HNO_3)* ☐ Sodium hydroxide (NaOH)* ☐ Other (specify) ☒ Calibration gas (Methane) ☒ Calibration gas (Isobutylene) ☒ Calibration gas (Pentane) ☒ Calibration gas (4-gas mixture) ☒ Calibration gas (zero air) ☐ Other (specify) ☒ Isopropyl Alcohol* ☐ Household bleach (NaOCl)* ☒ Sulfuric acid (H_2SO_4)* ☐ Hexane ☐ Other (specify) ***NOTE: Eyewash solution must be readily available on ALL project sites where materials are used or stored that pose a risk of getting into the eyes from splashes / airborne dust/debris, etc., including sample preservatives. The eyewash unit – stationary or portable – must be large enough to provide at least 15 minutes of eye flushing.**
Chemicals of Concern **In the section to the right, check any chemicals present onsite in any media (air, soil, water), or check "No ERM exposure to these".** **These chemicals include OSHA-regulated potential occupational carcinogens (29 CFR 1910.1003-1910.1016) as well as those chemicals for which OSHA has established specific respiratory protection requirements (29 CFR 1910.134)** **If any of these chemicals are present on site, contact your safety team member for guidance. Then, describe additional protective measures to be taken for boxes checked.**	☐ Friable Asbestos ☐ 3,3'-Dichlorobenzidine ☐ Benzidine ☐ beta-Propiolactone ☐ N-Nitrosomethylamine ☐ Lead ☐ Benzene ☐ Acrylonitrile ☐ Methylenedianiline ☐ 4-Nitrobiphenyl ☐ **No ERM exposure to these** ☐ alpha-Napthylamine ☐ bis-Chloromethyl ether ☐ 4-Aminodiphenyl ☐ 2-Acetylaminoflourene ☒ Vinyl chloride ☐ Chromium (VI) ☐ Coke oven emissions ☐ Ethylene oxide ☐ 1,3-Butadiene ☐ Methyl chromoethyl ether ☐ beta-Napthylamine ☐ Ethyleneimine ☐ 4-Dimethylaminoazobenzene ☐ Inorganic arsenic ☐ Cadmium ☐ 1,2-Dibromo-3-chloropropane ☐ Formaldehyde ☐ Methylene chloride Additional measures to be taken based on associated chemical hazard(s):

The following section must be filled out completely for all chemicals (suspected or confirmed) present in site media (soil, air, water). Attach an SDS for each chemical.								
Materials Present or Suspected at Site	**Highest Reported Concentration (specify units and sample medium)**	**Exposure Limit (specify *ppm* or mg/m^3)**	**IDLH Level (specify ppm or mg/m^3)**	**Primary Hazards of the Material (explosive, flammable, corrosive, toxic, volatile, radioactive, biohazard, oxidizer, or other)**	**Symptoms and Effects of Acute Exposure**	**Ionization Potential (eV)**	**Respirator Cartridge Type**	**Respirator Cartridge Replacement Schedule**
Trichloroethene (TCE)	Below TLV in breathing zone / personnel monitoring tests; potential high levels in soils.	PEL = 100 ppm REL = TLV = 10 ppm TWA = 10 ppm Skin Hazard ☒	1000 ppm	Carcinogenic, mutagenic; toxic.	Irritation of eyes, skin; headache, visual disturbance, lassitude dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury	9.45	FF APR with multi-purpose combination cartridges or SAR.	See North recommendations.
1,2-Dichloroethene	Below TLV in breathing zone / personnel monitoring tests; potential high levels in soils.	PEL = 200 ppm REL = TLV = 1 ppm Other= Skin Hazard ☐	50 ppm	Highly Flammable Liquid; toxic; CNS impairment, eye irritation.	Narcosis	9.65	FF APR with multi-purpose combination cartridges or SAR.	FF APR with multi-purpose combination cartridges or SAR.
1,1- Dichloroethene	Below TLV in breathing zone / personnel monitoring tests; potential high levels in soils.	PEL = 100 REL = TLV = 5 ppm TWA = 1 ppm Skin Hazard ☒	Not listed	Extremely Flammable; toxic if swallowed; potential human carcinogen.	Nausea, headache, vomiting, dizziness, drowsiness, confusion, incoordination, CNS depression	11.06	FF APR with multi-purpose combination cartridges or SAR.	FF APR with multi-purpose combination cartridges or SAR.
Vinyl Chloride	Below TLV in breathing zone / personnel monitoring tests; potential high levels in soils.	PEL = 1 ppm REL = TLV = 1 ppm Other= Skin Hazard ☒		Extremely flammable, carcinogenic; liver damage, lung damage.	Tremors, convulsions, respiratory disorder.	10.0	FF APR with multi-purpose combination cartridges or SAR.	FF APR with multi-purpose combination cartridges or SAR.
		PEL = REL = TLV = Other= Skin Hazard ☐						
		PEL = REL = TLV = Other= Skin Hazard ☐						

FOR ADDITIONAL CHEMICALS, USE THE LEVEL 2 HASP CHEMICALS TABLE ATTACHMENT.
PEL = OSHA Permissible Exposure Limit - http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992
REL = NIOSH Recommended Exposure Limit - http://www.cdc.gov/niosh/npg/default.html
TLV = ACGIH Threshold Limit Value (Contact your Division H&S Leader for additional information on these values).
IDLH = Immediately Dangerous to Life or Health - http://www.cdc.gov/niosh/npg/default.html

Levels of Personal Protective Equipment (PPE) Required for each Task	**Task Description**	Level of PPE			
		A	B	C	D
Primary hazard control strategies, including elimination/avoidance, engineering controls, and/or administrative controls, must be documented for all tasks on task-specific JHAs, to be included as an attachment to this HASP. PPE is considered as the "last line of defense."	Hand auguring / drilling until repeat samples have shown no contaminants above the 50% of the PEL; FF APR to be required until monitoring completed and contaminants below Action Level.	☐	☐	☒	☒
	Other jobs not specifically identified as high hazard in pre-job analysis and JSA	☐	☐	☐	☒
		☐	☐	☐	☐
		☐	☐	☐	☐
Signature of the H&S Team on Page 1 of this document signifies certification of PPE Hazard Assessment.		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐

Personal Protective Equipment (PPE) based on identified tasks to be performed, as outlined in Scope of Work.

Req = Required PPE for one or more tasks to be performed; required on site at all times. PPE specific to each task must be outlined in detail on task-specific JHAs.

NA = Not applicable to this project

PPE	Req	NA	PPE	Req	NA
Steel Toe Boots	☒	☐	Hard Hat	☒	☐
Long Sleeve Shirt & Long Pants	☒	☐	Safety Glasses w/ side shields	☒	☐
Outer Disposable Boots	☐	☐	Chemical/impact-resistant Goggles	☒	☐
Tyvek Suit	☒	☐	Poly-Coated Tyvek	☐	☐
Fully Encapsulated Chemical Suit	☐	☐	Full-Face Respirator	☒	☐
Hearing Protection	☒	☐	Half-Face Respirator	☐	☐
Leather Gloves	☒	☐	Inner Chemical Gloves	☐	☐
Outer Chemical Gloves	☒	☐	Other (specify)	☐	☐

Training, Medical Surveillance, and Safety Supplies

Req = Requirements are based on specific tasks performed in the field and the type of environments, chemicals or hazards encountered.

NA = Not applicable to this project

*Provides specialized training over-and-above the 40-hour HAZWOPER training necessary to serve as an on-site manager supervising employees engaged in work covered by the HAZWOPER standard at 29 CFR 1910.120

**Physical examination requirements should be discussed with WorkCare well in advance of the start of work to allow adequate time to schedule examination requirements.

Training	Req	NA	Medical Surveillance**	Req	NA
40-hr HAZWOPER; current 8-hr refresher	☒	☐	Medical Clearance	☒	☐
8 Hour HAZWOPER Supervisor*	☒	☐	Respirator Clearance and Fit Test	☒	☐
Current CPR and First Aid	☒	☐	Blood Lead and ZPP	☐	☐
MSHA 40-hr New Miner and current 8-hr refresher	☐	☐	Other (specify)	☐	☐
ERM Field Safety Officer (FSO)	☒	☐	Other (specify)	☐	☐
DDD Practice FSO/DM	☐	☐	**Supplies**	**Req**	**NA**
Subsurface Clearance (SSC)	☒	☐	First Aid Kit	☒	☐
EPA Hazardous Waste	☒	☐	Eyewash Solution (capable of 15 minutes of eye flushing)	☒	☐
Hazmat/Dangerous Goods Shipping	☐	☐	Air Horn	☐	☐
International Traveler	☐	☐	Decontamination Supplies	☒	☐
Other (specify):	☐	☐	Fire Extinguisher	☒	☐
Other (specify):	☐	☐	Potable Water	☒	☐
Other (specify):	☐	☐	Toilets	☒	☐
Other (specify):	☐	☐	Other (specify):	☐	☐

Monitoring Equipment: All monitoring equipment on site must be calibrated per manufacturer specifications (including daily bump tests) and results recorded. Under stable site conditions, measurements must be made in the breathing zone at least once every 30 minutes.				
Instrument (Check all required)	**Task**	**Instrument Reading**	**Action Guideline**	**Comments**
☒ Combustible gas indicator model:	☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	0 to 10% LEL	Monitor. Evacuate if confined space.	DOE Contractor (LATA Ky) contractually responsible for all IH monitoring and will provide relevant monitoring results and information to ERM.
		10 to 25% LEL	Potential fire or explosion hazard.	
		>25% LEL	Fire/explosion hazard. Evacuate site.	
☐ Oxygen meter model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	>23.5% Oxygen	Fire hazard. Evacuate site.	
		23.5 to 19.5% Oxygen	Normal oxygen levels.	
		<19.5% Oxygen	Oxygen deficient conditions. Evacuate site.	
☒ Radiation survey meter model:	☒ 1 ☒ 2 ☐ 3 ☐ 4 ☐ 5	Normal background	Proceed with normal operations.	Annual exposure not to exceed 1250 mrem per quarter. Background reading must be taken in area known to be free of radiation sources. DOE Contractor (LATA Ky) contractually responsible for all radiation monitoring and will provide relevant monitoring results and information to ERM.
		Three times background	Notify Radiation Safety Officer.	
		>Three times background	Radiological hazard. Evacuate site.	
☒ Photoionization detector model: ☒ 11.7 eV ☐ 10.6 eV ☐ 10.2 eV ☐ 9.8 eV ☐ _____ eV Level A-D PPE Requirements	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Any response below 0.5 ppm, sustained for 1 minute	Level "D" is acceptable up to the action level. For response above established background level(s), appropriate level PPE requirements must be met.	The action level for upgrading the level of protection is typically one-half of the lowest published exposure limit identified for the potential COCs at the site. For COCs with extremely low exposure limits (e.g., < 5 ppm), contact your Division H&S Leader or for guidance on action levels. Respirator selection should be based on the Assigned Protection Factor (APF) and the Maximum Use Concentration (MUC). To determine the appropriate respirator selection, the following contaminant information must be known: • Permissible Exposure Limit (PEL) or other published Exposure Limit (note that the lowest published exposure guideline should be used to establish action levels) • Short-term Exposure Limit • Ceiling Limit • Peak Limit • Any other exposure limit for the hazardous substance Contact your Division H&S Leader or Project Health and Safety Consultant for assistance in defining the APF and MUC, as necessary, as well as any time upgrading of respiratory protection is required based on established action levels.
		0.5 ppm to 25 ppm, sustained for 1 minute	Level "C" is acceptable as appropriate.	
		Greater than 5 ppm above background, sustained for 1 minute	Stop work. Tasks requiring Level B or Level A PPE are not anticipated during this project. If Level B or Level A PPE is needed, as determined by the FSO and/or the PM, the Division H&S Leader will be notified and the HASP will be revised.	

Instrument (Check all required)	Task	Instrument Reading	Action Guideline	Comments
☐ Flame ionization detector model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Any response above background to _____ ppm above background, sustained for 1 minute	Level "D" is acceptable up to the action level. For response above established background level(s), appropriate level PPE requirements must be met.	The action level for upgrading the level of protection is one-half of the lowest published exposure limit identified for the potential COCs at the site. Respirator selection should be based on the Assigned Protection Factor (APF) and the Maximum Use Concentration (MUC). To determine the appropriate respirator selection, the following contaminant information must be known: • Permissible Exposure Limit (PEL) or other published Exposure Limit • Short-term Exposure Limit • Ceiling Limit • Peak Limit • Any other exposure limit for the hazardous substance Contact your Division H&S Leader or Project Health and Safety Consultant for assistance in defining the APF and MUC, as necessary.
		_____ ppm above background to _____ ppm above background, sustained for 1 minute	Level "C" is acceptable as appropriate.	
		Greater than _____ ppm above background, sustained for 1 minute	Stop work. Tasks requiring Level B or Level A PPE are not anticipated during this project. If Level B or Level A PPE is needed, as determined by the FSO and/or the Project Health and Safety Consultant, the Division H&S Leader will be notified and the HASP will be revised.	
☐ Detector tube models:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Specify:	Specify:	
☐ Other (specify):	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Specify:	Specify:	

Work Zones **If exclusion zones are necessary because of chemical and/or equipment hazards. Describe the set-up of these zones. Include landmarks, dimensions as necessary, equipment vs. personnel decontamination zones**	Exclusion Zone: Exclusion zones will be established based on work activity and environmental conditions. When disturbing the earth (e.g., drilling), an exclusion zone will be set up, covering an area 50 feet diameter in all directions if contaminants (VOCs) are or may be above Action levels. Upon recommendation of site Industrial Hygienist or ERM FSO, the exclusion zone may be expanded in the direction of wind (as indicated by wind socks in area).Contingent upon Area monitoring by LATA Industrial Hygienists, the zone may be reduced in scope.
	Contamination Reduction Zone: Adjacent to EZ. The contamination reduction zone will be set up to provide adequate space for decontamination needs around the perimeter of the Exclusion zone. One decontamination station will be incorporated into the contamination reduction zone, upwind of the activity and will include waste barrels for disposable PPE and a wash station for respirators and other non-disposable PPE and equipment.
	Support Zone: The support zone shall extend outside of the contamination zone to allow for staging of materials. It shall be delineated outside normal traffic areas, outside areas subject to pother known hazards, and upwind of source emissions.
Site Access/Control **Describe procedures for limiting unauthorized entry to the work zone(s). Are there any security requirements?**	Access Control Procedures: All entrants are required to receive a security badge from site security prior to coming on site.. Only persons fully trained in hazardous waste operations and other relevant subjects and approved for respirator use may enter the Exclusion Zone and the Contamination Reduction Zone.;
Decontamination Procedures **Describe procedures for decontamination of personnel and equipment.**	Personnel: Wash hands with soap and water before leaving site. All personnel must follow the appropriate order for cleansing and removal during decontamination: • Boots; • Outer gloves; • Coveralls or protective suit; and • Inner gloves.

	Equipment: The following will be required for equipment and tool decontamination: • Before leaving the work area, excess contamination will be removed from the equipment and tools and placed in approved, properly labeled containers. • A decontamination area will be designated for cleaning all equipment that has been in contact with the site materials before leaving the site. All decontamination will be conducted on a gravel filled pad with an impermeable synthetic liner and fluid-containment berm. Equipment will be placed on the pad and rinsed, brushed and/or steam cleaned to remove any contamination. • Disposal of fluids generated from the decontamination process will be in accordance with approved work plans. • Disposal of all solids collected within the decontamination pad and the pad liner will be in accordance with approved work plans. • For major equipment, utilize a soap and/or water rinse and steam cleaning with temperature between 160 degrees to 180 degrees Fahrenheit with a pressure at or greater than 1,200 pounds per square inch (psi) will be the minimum required procedure.

Emergency Response Planning	**ALL WORK-RELATED INCIDENTS MUST BE REPORTED. FOR ALL MEDICAL EMERGENCIES, CALL 911 OR THE LOCAL EMERGENCY NUMBER.**
In the pre-work briefing and daily tailgate safety meetings, all onsite employees will be trained in the provisions of emergency response planning, site communication systems, and site evacuation routes. Note that clients may have their own procedures which may need to be followed. **Signal a site emergency or medical emergency with three blasts of a loud horn (car horn, fog horn, or similar device).** **To complete this section, attach a hospital route map to the HASP.**	**For ALL non-emergency incidents resulting in injury or illness, you must:** • Give appropriate first aid care to the injured or ill individual and secure the scene. • Immediately notify the Project Manager and/or Partner-in-Charge. • Immediately call WorkCare Incident Intervention at (888) 449-7787 (available 24 hours/7 days per week) (US only). • Clients may have their own procedures which we may need to follow. • Enter the event into the ECS within 24 hours. **In the event of an emergency that necessitates evacuation of the work task area or the site as a whole, the following procedures shall occur:** • The ERM FSO will contact all nearby personnel using the onsite communications system to advise of the emergency. • Personnel will proceed along site roads to a safe distance upwind from the hazard source. • Personnel will remain in that area until the site safety contact or other authorized individual provides further instruction. **In the event of a severe spill or leak, site personnel will follow the procedures listed below:** • Evacuate the affected area and relocate personnel to an upwind location. • Inform the ERM FSO, an ERM office, and a site representative immediately. • Locate the source of the spill or leak, and stop the source if it is safe to do so and appropriately trained personnel are onsite to do so. • Begin containment and recovery of spilled or leaked materials. • Notify appropriate local, state, and federal agencies after obtaining client consent to do so. **In the event of severe weather, site personnel will follow the procedures listed below:** • Site work shall not be conducted during severe weather, including high winds and lightning. • In the event of severe weather, stop work, lower any equipment (drill rigs), and evacuate the affected area.

Client Specific Emergency Response	
In the event of an emergency, client specific emergency response procedures may take precedent over ERM established procedures. **While engaging in field related activities on an active client site, measures they have in place to signal either emergency response or evacuation need to be reviewed and documented.** **Once completed, this summary, along with evacuation map(s), should be discussed with all visitors, subcontractors and others subject to HASP review upon site visit.**	Contributing factors initiating emergency response (process, material, weather) Plant Alarms (Radiation, attack, fire, severe weather, earthquakes, chemical/Hazmat releases, and other Plant emergencies as designated by LATA). Lights and/or sounds associated with evacuation Reference LATA HASP, section 11.2.5 for details: continuous blast for radiation an/or for emergency evaluations. Drill requirements for contractors on-site Primary Contractor (LATA) will conduct periodic drills with all personnel on site. Initial and alternative muster points Referencing map (attached), Area 6, north of C-400, others as applicable based on weather conditions and the nature of the emergency. Map associated with evacuation Attachment 1: Emergency Evacuation Map Specific evacuation procedures Follow LATA Procedure. In the event of an evacuation alarm, stop work, proceed to the evacuation area, account for your whereabouts to your supervisor. How does contractor account for all site visitors The site Safety Supervisor is responsible for accounting for all personnel (through their supervision) and reporting to LATA. PPE and Spill Kit requirements (if emergency response is spill related) Spill kits are provided on site for use by LATA personnel.

Emergency Contacts	Name	Location	Phone	Cell Phone
Hospital (attach map)	Lourdes	1530 Lone Oak Road	270-444-2444	
Police	Plant telephone Bell system 6246 or plant radio, channel 16 or 911 on cell phone			
Fire	Fire alarm pull box, plant telephone Bell system 333 or plant radio, channel 16 or 911 on cell phone			
Project Manager	Jay Dablow	Irvine	949-623-4686	714-606-9110
Field Manager (if not PM)				
Field Safety Officer (if not PM) --or--	Charlotte Dorrity David Duncan	Irvine Houston	707-490-5787 832-209-8801	707-490-5787 832-498-9345
Division H&S Contact	Steven Perkins	Irvine	949 623 4669	714 928 3608
Alternate H&S Contact	Bradley Bishop	Sacramento	916 924 9378	916-752-7989
Americas Region H&S Contact	Mark Hickey	Denver, CO	720-200-7172	720-625-2869
Incident Intervention (US Only)	WorkCare	NA	888-449-7787	NA
SSC Experienced Person	Andrew Roberts	Nashville, TN (will be on-site during all SSC activities)	615 656 7102	678 516 1633
Subcontractor Safety Contact(s)	Hauge, Scott Arne	Ocala, FL		

Client Site Contact	Jeff Seaton		270-816-4106	

Acknowledgement	***I have read, understood, and agree with the information set forth in this Health & Safety Plan, and will follow guidance in the plan and in the ERM North America Health and Safety manual. I understand the training and medical monitoring requirements for conducting activities covered by this WARN HASP and have met these requirements.*** ***ERM has prepared this plan solely for the purpose of protecting the health and safety of ERM employees. Subcontractors, visitors, and others at the site are required to follow provisions in this document at a minimum, but must refer to their organization's health and safety program for their protection.***		
Printed Name	Signature	Organization	Date

Approval Signatures **Signatures in this section indicate the signing employee will comply with and enforce this WARN HASP, as well as procedures and guidelines established in the ERM NA H&S. Signatures in this section also indicate that any subcontractors performing work under contract to ERM have met the minimum safety standards in the ERM Subcontractor Prequalification Process.**	Project Manager J F Dallow III	Date: 8/14/15
	Partner in Charge	Date:

Check all appropriate documents to be attached to this HASP.	☒ Site-specific JHAs for all tasks (including subcontractors) ☒ SDS/CSDC for all chemicals brought to site and all chemicals suspected/confirmed in site media ☒ SSC Project Plan ☒ Map of Route to Hospital/Emergency Services ☐ High-Hazard Work Procedures: Type: ☐ High-Hazard Work Permits: Type(s): ☒ Facility site map(s) ☒ Tailgate Safety Meeting Forms ☒ Air Monitoring and Equipment Calibration Forms ☒ SOS (See-Own-Share) Field Cards ☒ Emergency Drill Forms ☒ OFP Contractor Leaflet ☐ Risk Assessment Checklists ☒ Health & Safety Guidance Documents: List: ☒ Client specific requirements ☐ Travel Risk Assessment (TRA) ☐ PLAN Risk Assessment ☒ Field Audit Forms ☒ PM H&S Checklist ☒ Vehicle Safety Checklist ☐ IH Sampling Data Sheet ☒ Other (specify): LATA HASP, Ex D, GI, GII

See It – Own It – Share It	Stop Work Authority
It means that: • **We know that we have a responsibility to look out for each other, to intervene when necessary, to be proactive and to help keep safety issues from becoming problems.** • **We also look out for ourselves. If we recognize that a situation is unsafe, we are expected to stop what we're doing, reassess the situation and consult with others if necessary before proceeding safely.** • **We assign no blame to anyone who raises safety issues.** • **We strive to learn lessons from the large and small events that are part of our daily experience.**	**It is ERM policy that all ERM and ERM Subcontractor employees have the authority, without fear of reprimand or retaliation to:** • **Immediately stop any work activity that presents a danger to the site team or the public.** • **Get involved, question and rectify any situation or work activity that is identified as not being in compliance with the HASP or with broader ERM health and safety policies.** • **Report any unsafe acts or conditions to supervision or, preferably, intervene to safely correct such acts or conditions themselves.**

Revision Log	Date	By	Notes
	2/11/2013	S Perkins / M Griffin	Merged standard / intrusive L2 formats into single document. Revisions to include full HAZWOPER compliance, DDD practice applicability, and user feedback.
	5/2013	M. Griffin	Added additional user feedback.

ATTACHMENTS

1. **Health and Safety Plan for the C-400 Interim Remedial Action at the Paducah Geaseous Diffusion Plant, Padicah, Ky (LATA, 6/29/2011)**

2. **TWI: C-400 Steam Injection Operation**

3. **TWI: C-400 Steam Injection Construction and Decommission Activities**

4. **Map of Route to Hospital (Lourdes, 1530 Lone Oak Road, Paducah, KY – 270-444-2444)**

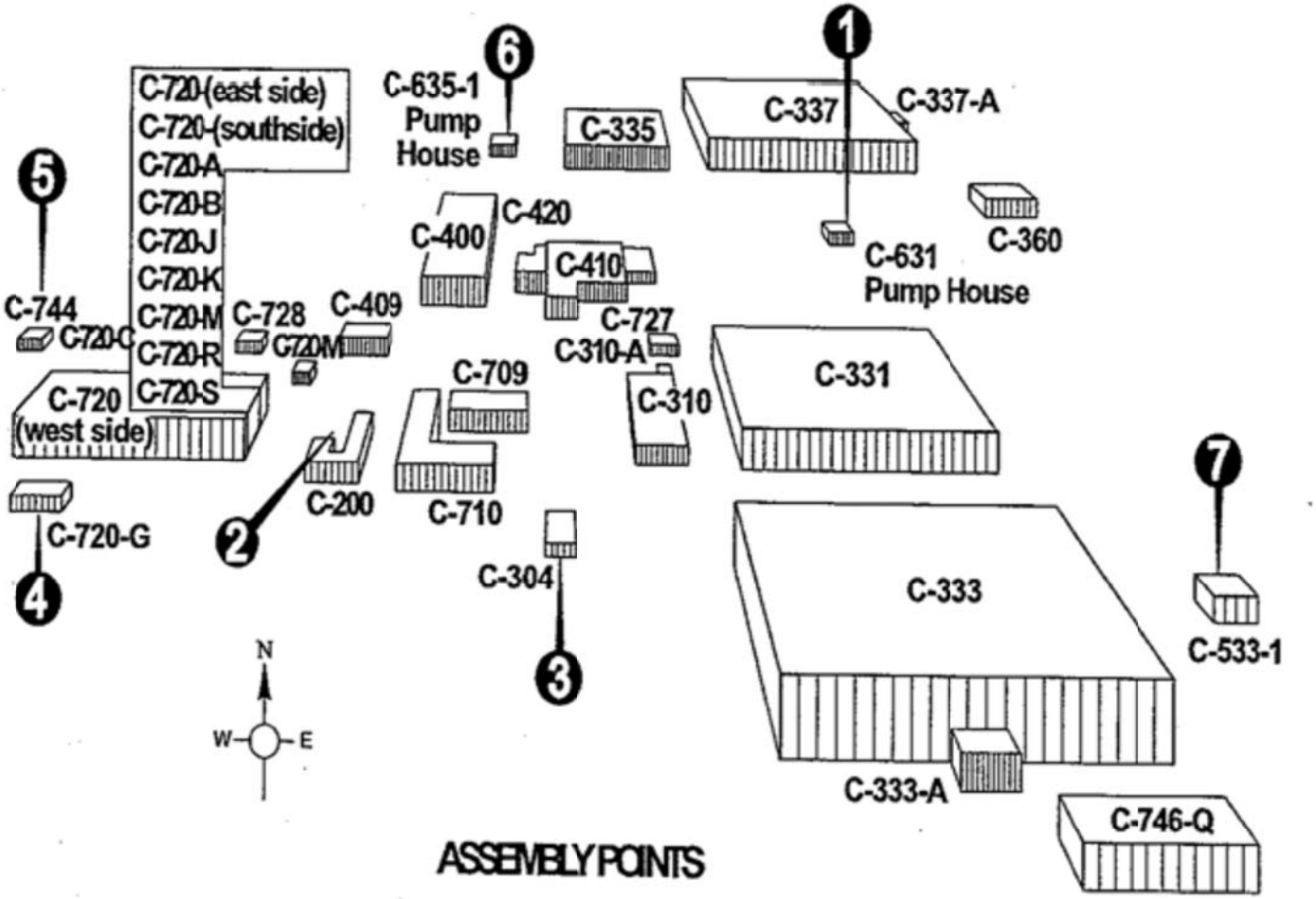
5. **Emergency Evacuation Assembly Map**

6. **SSC Project Plan**

7. **Field Audit Forms**

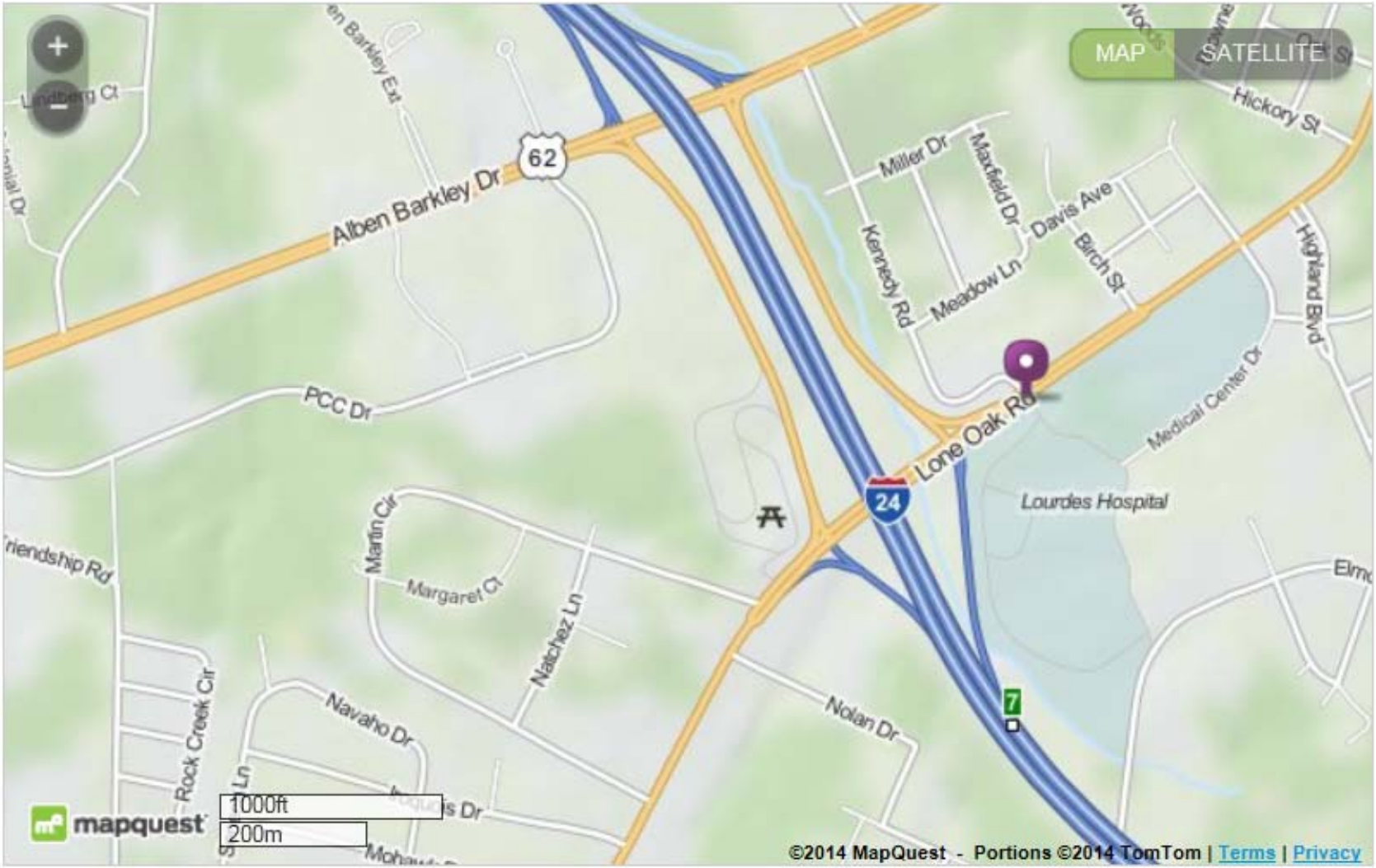
8. **Project Manager Health and Safety Checklist**

Attachment 5



Paducah Gaseous Diffusion Plant Assembly Points

Map of Route to Hospital (Lourdes, 1530 Lone Oak Road, Paducah, KY – 270-444-2444)



©2014 MapQuest, Inc. Use of directions and maps is subject to the MapQuest Terms of Use. We make no guarantee of the accuracy of their content, road conditions or route usability. You assume all risk of use. View Terms of Use

PAD-400-0048

Treatability Study Steam Injection Shakedown and Startup Procedure Subcontractor Submittal

This document is approved for public release per review by:

_____ _____

LATA Kentucky Classification Support Date

APPROVALS

Treatability Study Steam Injection

Shakedown and Startup Procedure

Subcontractor Submittal

PAD-400-0048

March 2015

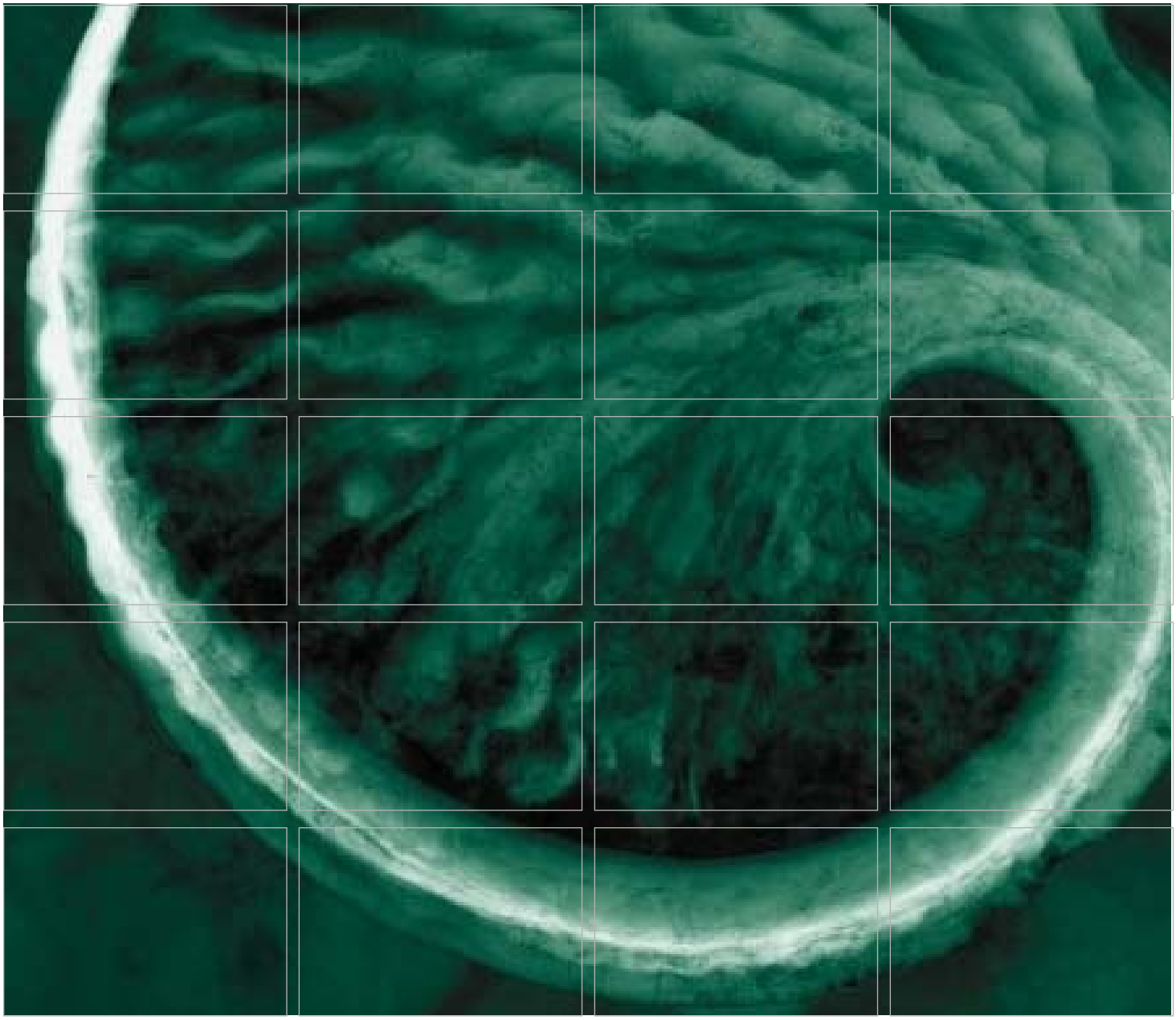
_____ _____

Todd Powers, GWOU C-400 Project Manager Date

Effective Date: _____

Review Date: _____

Nuclear Safety Documentation: ____NA_____



Treatability Study Steam Injection Shakedown and Startup Procedure

C-400 Phase IIb Steam Injection Treatability Study
Paducah, Kentucky, LKY-SC-036

Prepared for:
LATA Environmental Services
of Kentucky (LATAKY)

March 2015

www.erm.com

The world's leading sustainability consultancy

ERM

LATA Environmental Services of Kentucky (LATAKY)

Treatability Study Steam Injection Shakedown and Start-up Procedure

C-400 Phase IIb Steam Injection Treatability Study
Paducah, Kentucky, LKY-SC-036

March 2015

Project No. 0275655

Jay Dablow
Partner

Charlie Eischen
Senior Engineer

Environmental Resources Management
2875 Michelle Drive, Suite 200
Irvine, California 92606
T: 949-623-4700
F: 949-623-4711

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 PURPOSE 1

1.2 SCOPE 1

1.3 OVERVIEW OF SHAKEDOWN/CAT PHASES 2

1.4 COMMISSIONING 2

1.5 CONSTRUCTION/COMMISSIONING INTERFACE 2

2.0 SAFETY 4

2.1 PRECAUTIONS 5

3.0 COMMISSIONING 6

3.1 COMMISSIONING TEAM 6

3.2 COMMISSIONING ACTIVITIES 6

3.3 SYSTEM STARTUP TESTING (SST) 7

3.4. COMMISSIONING DOCUMENTATION 8

3.5 COMMISSIONING PUNCH LIST 8

3.6 TRANSITION: COMMISSIONING TO OPERATIONS 9

4.0 PREREQUISITE ACTIONS 10

APPENDIX A ELECTRIC STEAM BOILER ESB-1 PROCEDURES

APPENDIX B ELECTRIC SYSTEM STARTUP

APPENDIX C ARC FLASH CALCULATIONS

APPENDIX D TEMPERATURE MONITORING SYSTEM STARTUP

APPENDIX E STEAM INJECTION SYSTEM STARTUP

1.0 INTRODUCTION

1.1 PURPOSE

This procedure provides detailed steps for Shakedown/Construction Acceptance Testing (CAT) and initial startup of the C-400 Phase IIb Steam Injection Treatability Study (TS) Paducah, Kentucky (LKY-SC-036) steam injection system, for subsequent system startups, and for safely operating the system.

1.2 SCOPE

This procedure includes instructions to:

- Review the factory/fabrication shop "certificate of compliance" and acceptance testing activities for prefabricated equipment.
- Verify construction acceptance testing, described in Section 4.0 Prerequisite Actions below, of field installed systems.
- Plan, conduct, and document the shakedown/CAT, startup, and testing activities.
- Utilize applicable codes and standard practices for the testing and verification of facilities, equipment, and process systems.
- Organize and establish clear roles, responsibilities, and task assignments within the shakedown/CAT, startup, and testing phases.
- Optimize the efficiency of the shakedown/CAT and startup work activities.
- Use standard practices for the reporting of progress and direction of the work.
- Ensure safe work practices.
- Control documentation and control changes to the configuration (this includes as-built drawings).
- Notify key personnel in advance of system changes.
- Safely warm up steam injection piping in the system.
- Inject steam into subsurface sediments under normal conditions.
- Shut off the steam injection system completely.

- Shut off the steam injection system under emergency conditions (including emergency shutdown checklist).

1.3 *OVERVIEW OF SHAKEDOWN/CAT PHASES*

The work will progress in the phases described herein. A clear understanding of the interrelationship and scope of each phase is necessary to ensure an orderly progression of the work. The commissioning phases are summarized as follows:

1. Shakedown/CAT—Verification of mechanical and electrical completion, as determined by completion of TWI-0123, 0153, and 0154 (Section 4.0 Prerequisite Actions).

2. Shakedown—Functional testing of components and systems.

3. Startup Operation—The entire steam injection system and wells are operated and testing is conducted to ensure proper system operation. Data is collected to ensure the system is performing as designed.

This procedure is the guiding document for the shakedown/CAT phase and becomes part of the project record.

1.4 *COMMISSIONING*

During the Commissioning phase, responsibility for the direction of the day-to-day activities required to commission the system is held by the ERM Project Manager, or his designee. Reporting to the LATA Project Manager, the ERM Project Manager or his designee will manage the activities according to this plan and the schedule developed and approved by the LATA Project Manager. The ERM Project Manager or his designee will manage all activities of the Commissioning team. During the commissioning and initial startup phase, commissioning support activities performed by the U.S. Department of Energy (DOE) and LATA functional support groups, such as electrical maintenance, mechanical maintenance, radiological control (RADCON), industrial safety (IS), industrial hygiene (IH), etc. will be under the supervision of the frontline supervisor (FLS).

1.5 *CONSTRUCTION/COMMISSIONING INTERFACE*

The Site Superintendent has primary responsibility for completing construction in accordance with the appropriate Task Work Instruction (TWI). Commissioning and startup is the responsibility of the ERM Project Manager, or his designee. The following list further defines the Site

Superintendent and ERM Project Manager, or his designee, roles during construction and commissioning.

- CAT—All CAT will be completed as part of TWI-0123, 0153 and 0154. The Site Superintendent is responsible to ensure TWI completeness for each subsystem as a prerequisite to system startup testing (SST) performance. LATA Kentucky will conduct a crew briefing prior to commencing any TWI work.
- SST—Startup procedures are incorporated in this commissioning plan. The SST Checklist/Sign-Off sheets, which are provided within this plan, shall be thoroughly completed. The SST Procedures will be approved as part of this commissioning plan. Final SST Report will be included in the D1 final report. LATA Kentucky will conduct a crew briefing prior to commencing SST work.

2.0 SAFETY

All work activities associated with the startup and testing of the TS systems will be conducted in accordance with the following:

- DOE 10 Code of Federal Regulations (CFR) § 851.
- PAD-WC-0018 Work Planning and Control Program for the Paducah Environmental Remediation Project, Paducah, Kentucky.
- PAD-PLA-SAF-001 Integrated Safety Management System Description and Environmental Management System Description for the Paducah Environmental Remediation Project, Paducah, Kentucky.
- PAD-PLA-HS-001 LATA Environmental Services of Kentucky, LLC Worker Safety and Health Plan, Paducah Remediation Services Project.
- PAD-PROJ-0068, Health and Safety Plan for the C-400 Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky.

To ensure all work is performed safely and efficiently, work activities are planned and executed in accordance with PAD-WC-0018 and these Integrated Safety Management System (ISMS) core functions:

- Define Scope of Work
- Analyze the Hazards
- Develop and Implement Hazard Controls
- Perform Work within Controls
- Provide Feedback and Continuous Improvement

Personnel involved in the work activities will understand their authority, responsibility, and accountability to report unsafe conditions related to any work being performed and to suspend or stop work that they feel may endanger personnel safety, the environment, or the public in accordance with PAD-SH-2018, Stop/Suspend Work (Safety Related). Prior to energizing the electric steam boiler, the ERM Project Manager, or his designee will notify the LATA Project Manager to allow for determination of C-400 area operational restrictions (if any). Prior to operating noise generating equipment not operated during Phase I operations, a limited area of audibility will be established to allow for noise level evaluation by the deactivation contractor Criticality Accident Alarm System (CAAS) engineer. This evaluation will be utilized to

determine entry/access requirements while equipment is operating to maintain audibility of CAAS alarms.

2.1 PRECAUTIONS

A) Safety gloves (dry leather with gauntlets), hard hat with attached face shield in place, safety glasses, hearing protection, and full-length sleeve flame-resistant (FR) coveralls are required when venting or operating high-pressure steam systems to prevent personal injury.

B) Establish communications between the ERM staff and LATA staff and any other personnel participating in the performance of this procedure.

C) Avoid contact with hot steam line components.

D) Avoid contact with condensate drips or pools of hot condensate around free-blows or steam trap drains.

E) Report any abnormal conditions in the steam supply header to the ERM Project Manager.

F) Report any abnormal conditions in the steam distribution lines to the ERM Project Manager, LATA Site Technical Representative (STR) and to ERM principal project personnel.

G) All steam line components shall be operated slowly to allow adequate warmup, system reaction time, and adequate observation time.

H) Always be alert for symptoms of water hammer (i.e., loud knocking inside a steam line and/or excessive movement of the steam line) and perform remedial actions as outlined within the body of this procedure.

I) Water hammer or vibration may occur when opening any steam isolation valve and condensate is present in the Pressure Reducing Station and the steam distribution system. If excessive water hammering or vibration is observed, immediately close the valve and then verify all drains and free-blow valves are open and discharging condensate. The ER STR and ERM principal project personnel shall be notified immediately if damage occurs. Do not reopen the steam isolation valve until the cause of the water hammer is determined and eliminated.

J) Inspect the steam distribution lines throughout the treatment cell for signs of leakage or abnormal conditions as the system is being pressurized and placed in service.

3.0 COMMISSIONING

Commissioning follows the mechanical completion of major components of the system. Commissioning includes the verification of closeout of Construction Phase TWIs. During the commissioning phase, startup testing is managed by the ERM Project Manager. Support is provided by construction and operations personnel as required. Commissioning focuses on the newly installed equipment, but will encompass some facilities remaining from Phase IIa. Integrated testing will provide for the inspection of the Phase IIa materials.

3.1 COMMISSIONING TEAM

The ERM Project Manager or his designee will direct a commissioning team consisting of engineers and technicians proficient in their respective disciplines. The field teams are instructed in advance of the commissioning activities on the test and check-out procedures to be employed and the proper completion of the documentation.

3.2 COMMISSIONING ACTIVITIES

The activities to be performed during the commissioning phase are presented below:

- Initiation
  - Verification of piping and instrumentation diagram (P&ID) by walk down
  - Review of Punch List Items
- Instrumentation Check-out
  - Verification of Control Loop Checks
  - Verification of instrument calibration (or perform calibration checks)
  - Verification of Alarm Logic and Trip Actions
  - Making System Software Modifications, as required
- Electrical and Mechanical Check-out
  - Completed during closeout of TWI-0123, 0153, 0154

3.3 *SYSTEM STARTUP TESTING (SST)*

The activities to be performed during the commissioning phase include the start-up of the individual plant systems in a defined sequence. The following drawings are referenced in the performance of the SST:

- C7DC40000A027 Site Plan
- C7DC40000A028 Steam Injection Wells and Temperature Monitoring Points
- P7DC40000A059 Process Flow Diagram
- P7DC40000A060 Piping & Instrumentation Diagram (Sheet 1)
- P7DC40000A061 Piping & Instrumentation Diagram (Sheet 2)
- P7DC40000A062 Piping Plan
- P7DC40000A063 Wellhead and Piping Details
- E7DC40000A046 Electrical Power One-line Diagram
- E7DC40000A047 Electrical Pole, Transformer & PDP Details
- E7DC40000A048 Lighting Details
- E7DC40000A049 Communications Plan

The following are typical SST activities:

- Electric Steam Boiler (ESB-1) Operations (Appendix A)
  - Fill feed water and blowdown tanks and test level controls;
  - Test pump operation and recirculation through lines
  - Perform instrumentation and control functions checks
  - Test shutdown interlocks
  - Make adjustments as required.
- Electric System (Transformers and PDPs) (Appendix B)
  - Verify circuit breaker and fuse settings
  - Verify emergency trips interlocks
  - Check function and performance of breakers, including an arc flash analysis (Appendix C)
- Temperature Monitoring System (Appendix D)
  - Verify continuity of temperature monitoring system wiring
  - Check function of data acquisition modules

- Verify operation of data storage and HMI computer

This SST plan and appendices contain detailed lists of procedures for each part of the system. The completed checklists will be approved by the ERM Project Manager or his designee. The actions listed in the SST checklist/sign-off sheet are arranged in a logical fashion (e.g., check valve alignment, fill tank, start pump, check pressures, test automatic temperature monitoring system functions) and will be followed in that order in accordance with PAD-WC-0044, *Adherence to Performance Documents*, applicable technical specifications, design drawings, applicable codes and standards, and manufacturer's recommendations. The SST plan will make clear any items that must be completed in the listed sequence. The Site Superintendent or ERM Project Manager, or his designee will supervise the SST and generate initial startup data.

3.4 COMMISSIONING DOCUMENTATION

The following documentation from testing will be completed to finalize commissioning:

- Alarm testing form (TWI-0123, 0153, and 0154 will be verified during commissioning
- Interlocks testing form
- Commissioning punch list

3.5 COMMISSIONING PUNCH LIST

To aid in the monitoring of system completion status, a punch list will be prepared at mechanical completion of TWI-0123, 0153 and 0154 and maintained for the project duration throughout commissioning until TWIs are signed off and final transition from commissioning to operations is completed. Each item on the punchlist will be segregated into one of the following categories for ease of verification and noted on the punch list:

- Critical for startup
- Desirable for startup, but not critical
- Not necessary for startup, may be deferred until after startup

Punch List items for verification are documented on Form 400-F-0014.

3.6 *TRANSITION: COMMISSIONING TO OPERATIONS*

Transition of the steam injection system from commissioning to operations occurs following the successful completion of SST. The ERM Project Manager or his designee will notify the LATA Project Manager formally using the Application for Turnover Form (Form 400-F-0015). In addition, the ERM Project Manager or his designee will transmit formally an entire set of the commissioning documentation to the LATA Project Manager.

With the acceptance and endorsement of the "Application for Turnover" by the LATA Project Manager, a transition meeting is conducted by the LATA Project Manager and attended by the relevant parties. Any outstanding (and acceptable) punch list items within the scope of the commissioning effort are identified and the disposition and completion planned for these items. Once completed, the appropriate startup/ shutdown sequence detailed in Appendix E will be followed:

- Startup, normal operations
- Shutdown, normal operations
- Shutdown, emergency

4.0 PREREQUISITE ACTIONS

The following CAT related actions will be completed before the start of Shakedown/CAT testing of the steam injection system;

- Complete all tasks for TWI-0123, Mechanical system construction;
- Complete all tasks for TWI-0153, Electrical system construction;
- Complete all tasks for TWI-0154, Instrumentation system construction; and
- Conduct total system walk down to verify completion of above TWI tasks.

Appendix A
Inspection Checklists

CONTENTS

Form Number	Form Name	Page Number
400-F-0001	Hydrostatic/Pneumatic Test Report	A-1
400-F-0002	Pump Inspection Record	A-2
400-F-0003	Fan/Blower Inspection Record	A-3
400-F-0004	Vessel Inspection Record	A-4
400-F-0005	Lubrication Record	A-5
400-F-0006	Fastener Tightness Thread Engagement Record	A-6
400-F-0007	Grounding Checklist	A-7
400-F-0008	Above Ground Conduit Checklist	A-8
400-F-0009	Electric Motor Checklist	A-9
400-F-0010	Data Sheet, Cable Megger, Test 600 V and Less	A-10
400-F-0011	Power and Lightening Panels Checklist	A-11
400-F-0012	Lighting and Receptacles Checklist	A-12
400-F-0013	Motor Rotation Checklist	A-13
400-F-0014	Construction Punch List	A-14
400-F-0015	Phase IIb Application for Turnover	A-15

Form 400-F-0001

Hydrostatic/Pneumatic Test Report

	DATE:
PIPING SYSTEM:	
APPLICABLE CODE:	
DESCRIPTION:	
DESIGN SYSTEM PRESSURE: PSI HYDROSTATIC/LEAK TEST PRESSURE: PSI	
METHOD USED FOR TEST:	
REQUIRED TIME TEST PRESSURE HELD:	
TIME TEST STARTED:	**TIME TEST COMPLETED:**
ALLOWABLE LEAKAGE:	**ACTUAL LEAKAGE:**
TEST ACCEPTED: YES NO* *** IF :NO, explain:**	
REMARKS:	
CALIBRATION DATA	
GAUGE No.:	**CALIBRATION DATE:**
CALIBRATION DUE DATE:	
Test Completed By:	
Technician Print	Technician Signature
Accepted By:	
Operations Manager Print	Operations Manager Signature

400-F-0001 (5/2013)
PAD-400-0048

Review the Identified Source Document for This Form Prior to Attempting Completion
Complete all Forms in Accordance with PAD-WC-0044

Form 400-F-0002
Pump Inspection Record

PUMP INSPECTION RECORD

Pump P&ID Number: _____
Pump Size/Hp/Description: _____
Pump Location: _____
Manufacturer: _____
Model and S/N:

Check List Item	Status (Sat/Unsat/NA)	Inspected By (initials)	Date
Correct Specification per P&ID			
Base Leveled/Anchored			
Base Grouted			
Inlet/Discharge Piping Properly Supported			
Check Startup Lubrication Record			
Check Motor Startup Test Record			
Packing Gland Installation			
Coupling Guard Installation			
Seal Water Piping Complete/Flow Check			
Pump Rotates Freely by Hand			
Initial Alignment	**Value**	**Measured By** (initials)	**Date**
Horizontal Angular			
Horizontal Offset			
Vertical Angular			
Vertical Offset			
Post-Run In Alignment	**Value**	**Measured By** (initials)	**Date**
Horizontal Angular			
Horizontal Offset			
Vertical Angular			
Vertical Offset			

Remarks:

Inspected By: (Print, Sign, Badge)	Date:
QA/ QC Witness: (Print, Sign, Badge)	Date:
Engineering Acceptance: (Print, Sign, Badge)	Date:

Form 400-F-0003
Fan/Blower Inspection Record

FAN/BLOWER INSPECTION RECORD

EQUIPMENT NO..: _____

FAN TYPE: _____ FAN SIZE: _____

MOTOR H.P.: _____ FAN/MOTOR SPEED: _____

MEDIUM TEMP.: _____ DRIVE TYPE: _____

MFG.: _____ FAN RATING: _____

CHECKOUT PROCEDURE PERFORMED	PERFORMED BY (Initials)	DATE ACCOMPLISHED
FOUNDATION BOLTS TIGHTENED		
GROUT PROPERLY APPLIED		
FAN LUBRICATION TYPE USED: _____ AMOUNT: _____		
COUPLING CONNECTED		
INITIAL ALIGNMENT PERFORMED - VERTICAL OFFSET= _____ - VERTICAL ANGULAR= _____ - HORIZONTAL OFFSET= _____ - HORIZONTAL ANGULAR= _____		
BELTS AND PULLEYS INSTALLED BELT SIZES: _____		
COUPLING GUARD INSTALLED		
PIPING AND DUCT WORK IS INSTALLED & ALIGNED		
MOTOR IS WIRED CORRECTLY AND ROTATION CHECKED		
SHAFT IS FREE TO ROTATE		
BLOWER LOBE CLEARANCE:		
RUN-IN PERIOD PERFORMED: Date: _____		
Time: _____		

THIS FAN HAS BEEN INSPECTED/TESTED AND IS READY FOR FULL OPERATION.

INSPECTED BY: (Print, Sign, Badge)	DATE:
ENGINEERING ACCEPTANCE: (Print, Sign, Badge)	DATE:

Form 400-F-0004
Vessel Inspection Record

VESSEL INSPECTION RECORD

Vessel P&ID Number: _____
Vessel Description: _____
Vessel Location: _____
Pressure Relief Devices:

Check List Item	Status (Sat/Unsat/NA)	Inspected By (initials)	Date
Conformance with General Arrangement Drawing			
Conformance with Mechanical Drawings			
Code Compliance Certification			
Anchor Bolts Secure			
Vessel Pads Grouted			
Presence and Tightness of Fasteners			
Vessel Plumb			
Platforms and Ladders Secure			
Painting			
Relief Valve Setting			
Relief Valve Safety Seal			
Rupture Disc Rating			

Remarks:

Inspected By: (Print, Sign, Badge) Date:

Engineering Acceptance: (Print, Sign, Badge) Date:

400-F-0004 (5/2013) Review the Identified Source Document for This Form Prior to Attempting Completion
PAD-400-0048 Complete all Forms in Accordance with PAD-WC-0044

Form 400-F-0005
Lubrication Record

Date: _____

Component	**Lubrication Used**	**Quality/Level** Satisfactory (Sat) or Unsatisfactory (Unsat)	**Maintenance Mechanic** (initials)

Comments:
_____
_____
_____
_____

Performed By: _____ **Date:** _____
(Print, Sign, Badge)

Operations Manager Acceptance: _____ **Date:** _____
(Print, Sign, Badge)

Form 400-F-0006
Fastener Tightness /Thread Engagement Record

FASTENER TIGHTNESS/THREAD ENGAGEMENT RECORD

	P&ID TAG NO.	SKID DESCRIPTION	FASTENER TIGHTNESS CHECKED		FASTENER ENGAGEMENT CHECKED		COMMENTS
			DATE	SIGNATURE	DATE	SIGNATURE	
ELECTRIC STEAM BOILER							
ELECTRIC SYSTEM							
TEMPERATURE MONITORING SYSTEM							

400-F-0006 (5/2013)
PAD-400-0048

Review the Identified Source Document for This Form Prior to Attempting Completion
Complete all Forms in Accordance with PAD-WC-0044

Form 400-F-0007
Grounding Checklist

Item	Performed By (Initials)	Remarks
Location:		
From:		
To:		
Correct Conductor		
(A) Size		**Size Cable:**
(B) Type		**Insulation:**
Proper Thermal Connection		
Proper Insulation of Joint		
(A) Proper ROD		**ROD Size:**
(B) ROD Location		**Distance:**
(C) Size		**Size Conductors:**
(D) Connections		
Ground Conductor Burial		
Depth		**Feet:**
(A) Location		
(B) Type		
(C) Size		
(D) Protection		
Ground Continuity check		**Date:**
Witness Resistance Test		**Date:**
(A) Ground Wells		**OHMS:**

Performed By:_____ **Date:** _____
(Print, Sign, Badge)
Frontline Supervisor: _____ **Date:** _____
(Print, Sign, Badge)

Conformance: **Yes** ☐ **No** ☐

Nonconformance Items: _____

400-F-0007 (5/2013) Review the Identified Source Document for This Form Prior to Attempting Completion
PAD-400-0048 Complete all Forms in Accordance with PAD-WC-0044

Form 400-F-0008

Above Ground Conduit Checklist

Item	Performed By (Initials)	Remarks
Location:		
From:		
To:		
Supports		
Spacing of Conduits		
Size: Conduit/Cable Size Per Drawing		**Drawing No.**
Clean		
Stub-Ups Protected/Open Ends Plugged		
Permanent Tagging		
Bending Free of Deformities		
Expansion Joints Installed		
Grounding Secured		
Bonding Installed Correctly		
Threads Fully Engaged		
No Wrench Cuts		
Bushings Installed		
Covers/Seals Installed		
Drains Installed		
Galvanized, Aluminum, PVC and PVC Coated conduit Used Where Specified		
Flexible Conduit: Grounded Fittings		
(A) Leveled		
(B) Supported		
(C) Proper Hubs		
(D) Locknuts/Bushings		
Hold Point		**Check Packing**
Seal Poured		

Performed By:_____ **Date:** _____
(Print, Sign, Badge)

Frontline Supervisor: _____ **Date:** _____
(Print, Sign, Badge)

Conformance: **Yes** ☐ **No** ☐

Nonconformance Items: _____

Form 400-F-0009
Electric Motor Checklist

Location: _____

Motor No.: _____ **Motor Service:** _____

Motor Manufacturer: _____

Serial No.: _____ **Horsepower:** _____

RPM: _____ **Voltage:** _____ **Phase:** _____

F.L. AMPS: _____ **Service Factor:** _____

Temp Rise: _____ **Insulation Class:** _____

Enclosure: _____ **Frame:** _____

kVA Code: _____ **Type:** _____

Model No.: _____ **Area Classification:** _____

MEGGER READING: (10 HP and above only)

A-Phase to Ground: _____ **A-Phase to B-Phase:** _____

B- Phase to Ground: _____ **B-Phase to C-Phase:** _____

C-Phase to Ground: _____ **C-Phase to A-Phase:** _____

INSTALLATION

Leveled: _____ **Overload Htr:** _____

Shims/Jack Screws: _____ **Breaker Setting:** _____

Bolts Tight: _____ **Starter Size:** _____

Grounded: _____

Performed By:_____ **Date:** _____
(Print, Sign, Badge)

Frontline Supervisor: _____ **Date:** _____
(Print, Sign, Badge)

Conformance: **Yes** ☐ **No** ☐

Nonconformance Items: _____

Form 400-F-0010

Data Sheet, Cable Megger Test 600 V and Less

Date: _____

Location: _____

Cable No.: _____ **Cable Length:** _____

Cable Size: _____ **No. Conductors:** _____

Cable Rated Voltage: _____ **Cable Insulation:** _____

Ambient Temperature: _____ **Relative Humidity:** _____

Megger Test Voltage: _____ **Hand:** _____ **Motorized:** _____

Megger Type: _____ **Serial No.:** _____

Conductor Number	Meg-OHMS	Continuity		Conductor Number	Meg-OHMS	Continuity	
		Pass	Fail			Pass	Fail

Performed By: _____ **Date:** _____
(Print, Sign, Badge)

Frontline Supervisor: _____ **Date:** _____
(Print, Sign, Badge)

Conformance: **Yes** ☐ **No** ☐

Nonconformance Items: _____

400-F-0010 (5/2013) Review the Identified Source Document for This Form Prior to Attempting Completion
PAD-400-0048 Complete all Forms in Accordance with PAD-WC-0044

Form 400-F-0011

Power and Lighting Panels Checklist

Location: _____		**Panel Board: _____**
Item	**Performed By (Initials)**	**Remarks**
Check For Damaged Or Missing Parts		
Enclosure Fits Area Classification		
Panel Board Schedule Filled Out		
Correct C.B. Size And Location		
Neutral Feed Properly Identified		
Grounding Installed And Connected		
Check Off Panel Board Phase Balance		**Date:**
Seals Installed		
Seal Poured		
Mounting And Supports		
Fixtures And Receptacles Comply With Drawing		**Wire:**
		Circuits:
Correct Wattage And Voltage Circuitry Correct To:		**Volts:**
		Amps:
Drawing Assignment		**Prim Volts:**
Nameplate Data:		**Sec Volts:**
Lighting Panel:		**Model No.:**
Power Panel		**KVA:**
Transformer		**Phase:**

Performed By:_____ **Date:** _____
(Print, Sign, Badge)

Frontline Supervisor: _____ **Date:** _____
(Print, Sign, Badge)

Conformance: **Yes** ☐ **No** ☐

Nonconformance Items: _____

Form 400-F-0012

Lighting and Receptacles Checklist

Location: _____			
Item		**Performed By (Initials)**	**Remarks**
1.	**Lighting**		
	No visible damage or missing parts		
	Fixture and lamp are correct		
	Ballast is correct		
	Fixture mounting detail		
	Conductor insulation is correct		
	Grounding conductors are secure		
	Lighting C.B. size is correct		
	Panel schedule is correct		
	Neutral conductor color code and size are correct		
2.	**Receptacles**		
	Proper voltage and capacity		
	Outlet location correct		
	Circuit branch conductors are the proper size		
	Ground is correct and secure		
	C.B. is correct for each branch CCT		
	Neutrals are identified & sized		

Performed By:_____ **Date:** _____
(Print, Sign, Badge)

Frontline Supervisor: _____ **Date:** _____
(Print, Sign, Badge)

Conformance: **Yes** ☐ **No** ☐

Nonconformance Items: _____

Form 400-F-0013
Motor Rotation Checklist

C-400 PHASE IIb MOTOR ROTATION CHECKLIST

Power Panel	P&ID Tag	HP	Description	Comments	Motor Rotation Check			
					Date Checked	Date Confirmed Correct	Initials	Status

Performed By: _____ **Date:** _____
(Print, Sign, Badge)

Frontline Supervisor: _____ **Date:** _____
(Print, Sign, Badge)

Conformance: **Yes** ☐ **No** ☐

Nonconformance Items: _____

C-400 INTERIM REMEDIAL ACTION PHASE IIb CONSTRUCTION PUNCH LIST

Punch List Entry Number	System		Component	Date Entered Initials, Date Badge	Punch List Description	Date Cleared Initials, Date Badge
	SVGTS (✓)	ERH (✓)				

Form 400-F-0014
Construction Punch List

Form 400-F-0015
Phase IIb Application for Turnover

Turnover: Construction to Commissioning/Operations

System/Equipment and Turnover Work Package(s):

_____

_____
(Attach additional sheets as necessary)

The above-referenced equipment or system is mechanically complete and ready for commissioning/SST testing.

Construction Superintendent: _____ _____ _____
Print Sign Date

☐ Unconditional Turnover ☐ Conditional Turnover; Punch List Attached

I have inspected the above equipment or system and have found it complete and sufficient to begin commissioning/SST testing.

Operations Manager: _____ _____ _____
Print Sign Date

The above equipment or system has undergone commissioning/SST testing and is ready to begin Batch mode operation

Operations Manager: _____ _____ _____
Print Sign Date

CAT, SST, Commissioning, and Batch mode operation has been successfully completed, and system is ready for full operations.

Operations Manager: _____ _____ _____
Print Sign Date

GWOU Project Manager: _____ _____ _____
Print Sign Date

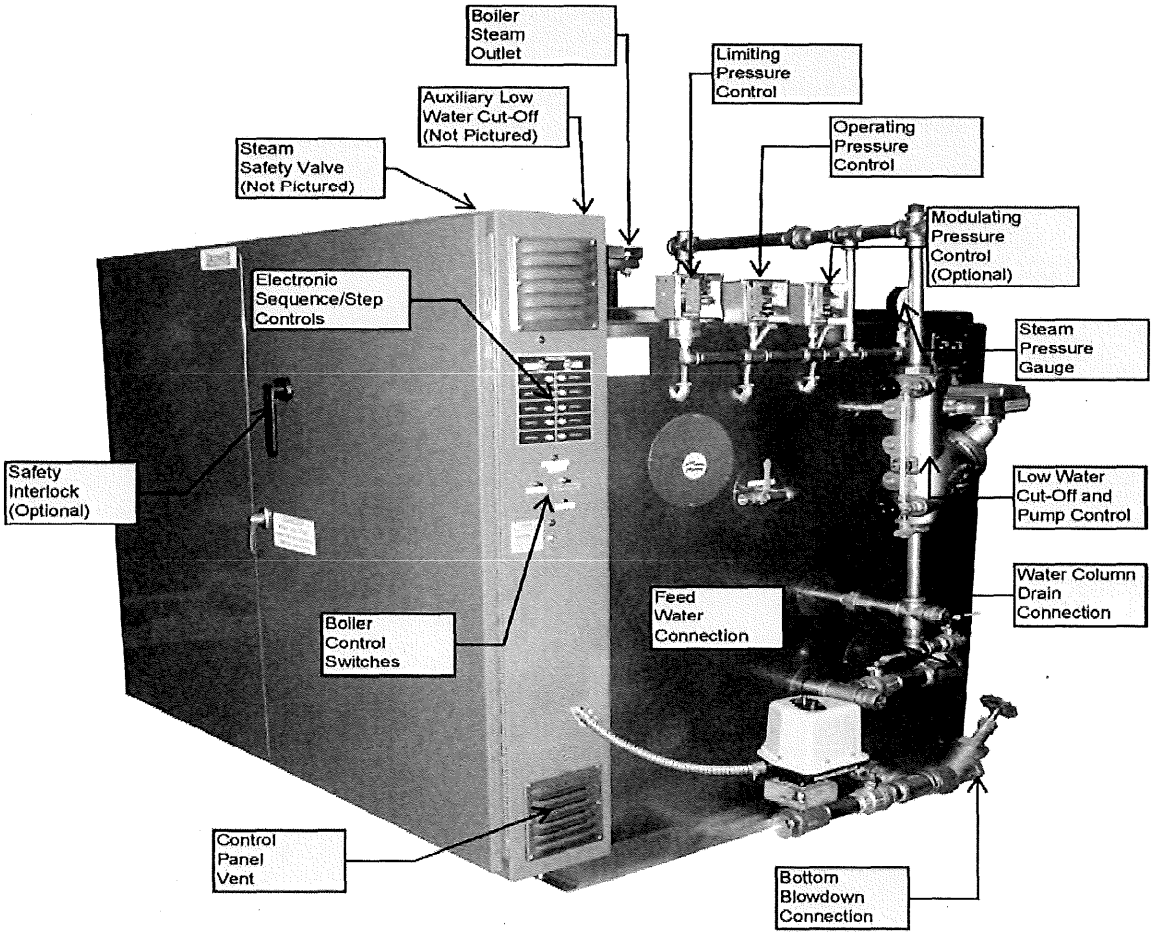
Appendix B
Electric Steam Boiler ESB-1
Procedures

Section II: Instructions

WARNING: All installation procedures must be followed completely by a competent installer familiar with boilers and boiler accessories.

CAUTION: Read and follow all instructions before installing any boiler equipment. All cover plates, enclosures and guards must be maintained and in place at all times, except during maintenance and servicing.

1. Illustration



Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

2. Unloading

The boiler was loaded by Lattner (including any accessories) and accepted by the transport company as undamaged. Before unloading the equipment, determine whether any shipping damage is apparent. Once the equipment is lifted from the trailer, any damage sustained during transit and not filed with the transport company will be the responsibility of the rigger or purchaser.

2.1. Lifting

The boiler will arrive secured to a wooden skid/pallet and will include a lifting lug (top of the boiler). When moving or lifting the unit, **DO NOT** attach sling around the boiler in an attempt to pull the boiler.

2.2. Forklift

If lifting with a forklift, extended forks should be used beneath the skid. Care must be taken to ensure that the boiler sits correctly on the forks such that the unit does not topple. Always note the weight of the boiler relative to the lifting capacity of the forklift.

2.3. Crane or Boom

When lifting with a crane or boom, attach the hook to the lifting lug on top of the boiler. **DO NOT** attach slings or chains to any part of the boiler, or boiler piping.

3. Rigging

Always use a competent rigger that has experience moving and setting boilers. If the unit will be moved into the permanent location with a forklift, crane, or boom, follow the directions in section 1. However, if moving the unit through a tight space or into an area that will not permit a forklift, place the boiler on rollers or on 2 inch pipes and roll the boiler into place. If the unit is dragged, attach chains to the base frame only.

If the entry way is too narrow for the boiler and controls to pass through, removal of the trim and controls can be executed. One should properly denote all wiring and piping connections and match mark accordingly for attachment after the boiler is placed. It may be helpful to use a digital camera to record the location of trim items for reference.

4. Placement of Boiler

4.1. Floor

Boiler must be placed on a level, noncombustible surface. **NEVER** install boiler on a wood floor or any other combustible surface (i.e., carpet, linoleum).

5. Steam Outlet

5.1. Pipe Size

Size pipe according to system requirements.

5.2. Outlet Size

Refer to product literature sheet for steam outlet size on a particular boiler model.

Lattner Boiler Company
14119th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

5.3. Steam Stop Valve

Install a steam stop valve in the steam line as close to the boiler as is practical. A steam stop valve allows the boiler to be isolated from the system during service work and may be helpful in throttling steam flow. Required by ASME Code if the boiler is operated over 15 psi. Valve should be rated for the maximum design pressure of the boiler.

5.4. Steam Piping

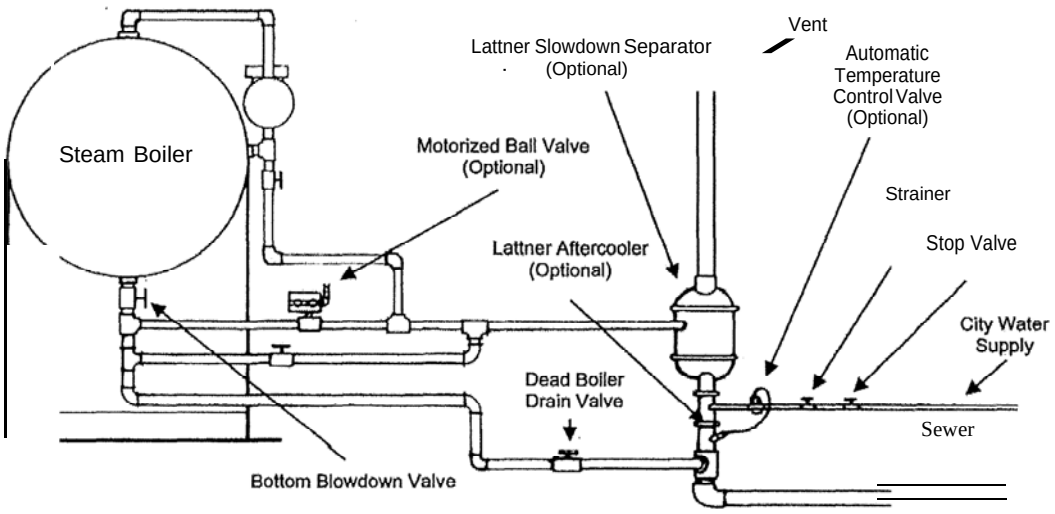
The steam line should be pitched downward slightly away from the boiler, toward a steam trap. If using a steam solenoid valve, the steam line should slope upward slightly to the solenoid valve. After the solenoid valve, the steam line should slope downward.

5.5. Codes & Standards

Piping must comply with all industry standards (especially ANSI 831.1) and all state and local codes.

6. Slowdown Piping

6.1. Boiler Bottom Slowdown (See Diagram Below)



6.1.1. **DO NOT REDUCE.** Slowdown piping and all fittings must be the same size as the boiler blowdown connection (refer to product literature sheets).

6.1.2. Low pressure boilers, operating at 15 psi or less, require one blowdown or drain valve. The pressure rating of the valve must be equal to or greater than the pressure of the boiler but not lower than 30 psi.

6.1.3. Boilers operating 16 psi to 100 psi require a single blowdown valve. A Y-type or a ball valve is acceptable.

6.1.4. Boilers operating 101 psi to 150 psi require piping designed for a pressure of 125% of the boiler safety valve set pressure (schedule 80 blowdown piping), one slow opening valve

Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

and one quick opening blowdown valve. If cast iron, these valves must be class 250. If steel, these valves must be class 150, or if bronze, a WSP rating of at least 200.

6.1.5. Standard globe and gate valves that form a pocket inside the valve are not acceptable blowdown valves. Y-type and ball valves are acceptable blowdown valves.

6.1.6. All blowdown piping must meet ANSI 831.1 code and all city and state codes.

6.1.7. Galvanized piping is not acceptable for boiler blowdown piping.

6.2. Automatic Bottom Slowdown

A Lattner automatic bottom blowdown valve may be used in place of one of the manual blowdown valves.

6.3. Water Level Control Drain Valve

A water column type level control is supplied with one drain valve. Connect the control drain line into the bottom blowdown line after the second bottom blowdown valve.

6.4. Slowdown Discharge

All boiler blowdown water must be discharged to a safe location, specifically to a blowdown separator.

6.5. Slowdown Separator

Select a Lattner blowdown separator according to the size of the boiler blowdown connection:

%or 1 inch	Model810
Up to 1-1/2 inches	Model1450

6.6. Slowdown Separator Inspection Opening

The extra coupling in the separator vessel is an inspection opening. The inspection opening will be plugged.

6.7. Slowdown Separator Vent

The blowdown separator must be vented to atmosphere. Vent pipe must discharge outside through the roof. **DO NOT** reduce the vent pipe size. **DO NOT** connect the vent pipe from the condensate tank to the separator vent unless absolutely necessary.

6.8. Slowdown Separator Drain

The water leaving the separator through the drain should be piped to the sewer. Some codes require the water to pass through an air gap before entering the sewer.

6.9. Aftercooler

If the water must be cooled before entering the sewer (required by some city and/or state codes), then an aftercooler must be used. The aftercooler attaches to the blowdown separator drain

Lattner Boiler Company
14119th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

connection and mixes cold water with the hot drain water. Units may be either manual or automatic. Select the aftercooler according to blowdown separator drain size.

205A (auto) or 205M (manual)	Model 810
301A (auto) or 301M (manual)	Model1450

6.10. Cooling Water Supply

Connect cold water supply pipe to aftercooler:

205A (auto) or 205M (manual)	1/2 inch NPT
301A (auto) or 301M (manual)	1 inch NPT

6.11. Dead Boiler Drain Valve

For draining the boiler when it is cool and not under pressure, the entire drain line must be lower than the bottom of the boiler. Pipe to sewer or floor drain. Valve must be rated up to the maximum allowable working pressure of the boiler.

6.12. Codes & Standards

All blowdown piping, drain and sewer connections, water piping and separator connections must be done in strict compliance with all applicable codes.

7. Safety Valve

7.1. Installation

Be sure safety valve is threaded securely into the boiler or into the boiler. The safety valve will always be installed in the upright position.

7.2. Discharge

Pipe the safety valve outlet to a safe point of discharge. DO NOT reduce the safety valve discharge piping. NEVER plug the safety valve outlet.

7.3. Supports

Safety valve piping should be secured by clamps or braces to a wall or structural member. Do not allow the discharge piping to hang on the safety valve.

7.4. Codes & Standards

All safety valve piping and supports must conform to all applicable codes.

8. Boiler Feed Systems

8.1. Condensate Return Systems

8.1.1. Make-Up Water Supply

Connect city water line to the float valve with the boiler feed system. Install a manual shut-

Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

off valve in the water line.

LV8 through LV35	1/2 inch NPT
LV60 through LV100	3/4 inch NPT

8.1.2. Pump Suction Line

This is pre-piped from the factory with an isolation valve and strainer.

8.1.3. Pump Discharge Line

DO NOT reduce. Use 1 or 1-1/4 inch NPT pipe and fittings between pump and boiler. Install two spring-loaded check valves. Install a hand shut-off valve between the last check valve and the boiler. Keep the number of elbows and fittings to a minimum.

8.1.4. Condensate Return Line

Condensate from all steam traps should be tied into a common return line. The condensate return line should be pitched downward toward the condensate return tank.

8.1.5. Condensate Return System Vent

Condensate return tank must be properly vented to atmosphere. Vent should discharge through the roof or through a wall to the outside. DO NOT reduce the vent pipe size.

LV8 through LV35	1 inch NPT
LV60	1-1/4 inch NPT
LV75	1-1/2 inch NPT
LV100	2-1/2 inch NPT

8.1.6. Condensate Return System Overflow

Pipe to floor drain. Overflow connection should be at least as large as the condensate return.

8.1.7. Condensate Return System Drain Connection

Pipe to floor drain. Install a valve in the line. 1 inch NPT line is sufficient.

8.2. Solenoid Water Valve

8.2.1. Water Pressure

This system will work only if the water supply pressure is at least 10 psi higher than the boiler operating pressure.

8.2.2. Water Inlet

Refer to the boiler assembly print for correct connection and location of the feedwater inlet.

8.2.3. Piping

Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

The solenoid water valve assembly will be piped in the following order: Y-type strainer, solenoid valve, spring-loaded check valve, globe valve, and boiler. All pipe is 1/2 inch NPT.

8.2.4. Water Supply

Connect water supply to the strainer.

9. Electrical Connections

CAUTION: All electrical work shall be done by a competent electrician. All wiring must be done in strict accordance with the National Electrical Code and any state or local codes.

9.1. Reconnecting Controls

If the boiler was shipped with controls removed, re-connect the wires according to the wiring diagram. All wires that need to be reconnected will have a tag indicating the control or terminals to which they must be connected.

9.2. Electrical Supply (See wiring diagram unique to boiler supplied for voltage requirements)

9.2.1. Connect incoming power supply from a fused disconnect or circuit breaker to the incoming terminal blocks in the boiler panel.

9.2.2. Supply 120 volt single phase from a separate fused disconnect. Use a 15 amp circuit breaker or fused disconnect if the boiler has a solenoid water feed valve or a pump motor 1/2 hp or less or a motor starter for a three phase pump. Use a 20 amp circuit breaker or fused disconnect if the boiler has a 3/4 hp pump motor, 120 volt single phase.

9.2.3. If boiler has a control circuit transformer, there is no need for a separate 120 volt power source.

9.3. Wiring Water Feed System

Wire the solenoid water valve, boiler feed pump or pump motor starter as indicated on the wiring diagram.

10. Before Starting the Boiler

10.1. Spare Fittings

Check that all unused pipe nipples are plugged or capped.

10.2. Float Block

Remove the float block screwed into the body of the McDonnell Miller level control. Replace with a malleable iron plug (supplied with the boiler).

10.3. Condensate Return System

Make sure there is make-up water supply to the tank. Make sure there is water in the tank.

10.4. Turn Pump Switch "ON"

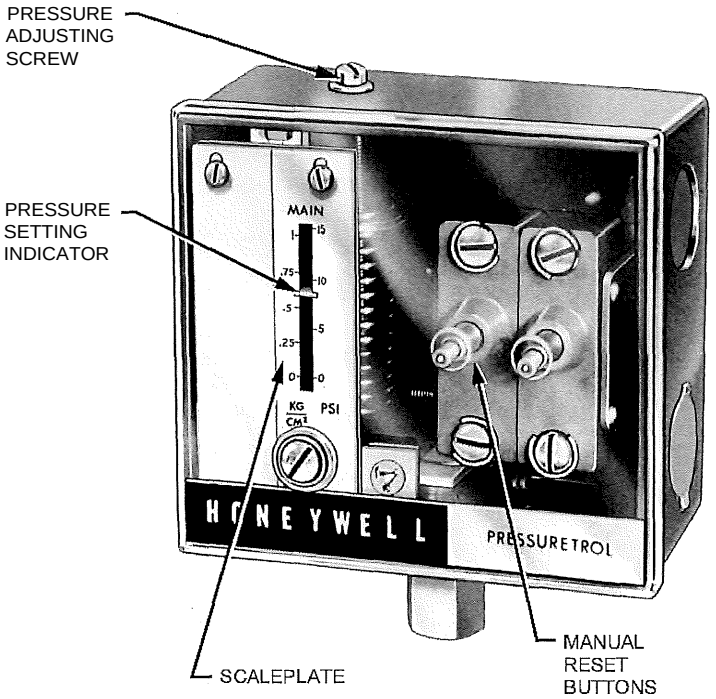
Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, lA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

Turn on the pump switch. Pump or solenoid valve should start immediately. If not, see the troubleshooting section of this manual.

10.5. Check for Leaks

While the boiler is filling, check for leaks in the piping and around the boiler. If there are leaks, turn off the pump switch and fix all leaks before continuing.

11. Pressuretrols: Controller and Limit (See Diagram Below)



11.1. Standard

All Lattner boilers will have at least two pressure switches, a "controller" and a "limit".

11.2. Controller

Before the boiler is started, the steam pressure is 0 psi. At this point, the controller is in the "on" condition and is calling for heat. When the boiler switch is turned on, the boiler will start generating steam. As the boiler warms, the steam pressure will rise. When the steam pressure reaches the controller's set point, the controller will shut off the burner. As steam is used, the pressure will begin to drop. When steam pressure drops enough, the controller will start the heating element again. The controller will continue to operate in this manner to maintain boiler pressure.

11.2.1. Controller (See Pressuretrol Diagram on Page 12)

On the left side of the pressuretrol is the set point indicating scale labeled "MAIN". Turn the main scale adjustment screw until the set point indicator aligns with the desired operating

Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

pressure. Turn screw clockwise to increase pressure, counterclockwise to decrease pressure.

11.2.2. Differential

When the boiler pressure reaches the set point the controller shuts off the heating element. The pressure must drop by a set amount before the controller will turn on the heating element again. That amount is called the differential. The differential is adjustable.

11.2.3. Setting the Differential (See Pressuretrol Diagram on Page 12)

On the far left side of the pressuretrols is the differential indicating scale labeled "DIFF". Turn the differential adjusting screw until the indicator aligns with the desired differential. A minimum differential will maintain the boiler pressure closer to the set point. A larger differential will help prevent rapid on and off cycling of the boiler, but may cause unwanted pressure drops before restarting.

11.3. Modulating Controller (Optional)

An optional modulating pressure controller may be supplied with boiler. Modulating pressure controller with potentiometer is controlled by a sequence or step controller for boilers with multiple stages. (See controller and sequencer/step controller manuals for additional information).

11.4. Limit

The limit switch is similar in operation to the controller but has a slightly higher set point. If the controller fails to shut off the boiler and the steam pressure continues to rise, the limit switch will shut down the boiler. The controller is an operating switch; the limit serves as an auxiliary safety cut-off. The limit switch is supplied with a manual reset function. If the steam pressure trips the high limit switch, the limit locks in the off position. The limit switch will not reset until the manual reset lever is pressed. Mercury switch limits have reset buttons on top. Snap switch limits have reset buttons on front.

11.4.1. Setting the Limit

This is done using the same procedure as for the controller. The limit setting will be higher than the controller's set point. For low pressure boilers (15 psi or less), set the limit switch 1 psi lower than the safety valve setting. For high pressure boilers, set the limit switch at least 10 psi higher than the controller and 5 psi lower than the safety valve setting.

11.5. Night Operating Pressure Switch

A third pressure switch may be supplied as an option. This switch allows the boiler to operate at low pressure at night for heating the building. Set the night operating pressure switch at approximately 10 psi. The boiler panel box will also be wired with a High/Low selector switch. Setting the selector switch at "Low", the boiler will operate at 10 psi. When the switch is turned to "High", the night operating switch is by-passed and the boiler operates at the normal operating pressure.

11.6. Example

Boiler with a 100 psi safety valve. Set the controller at 80 psi with an 8-10 psi differential. Set the

Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

limit switch at 90 psi. Turn on the boiler, heating element will start. When the steam pressure reaches 80 psi, the controller shuts down the heating element. When the pressure drops to 70-72 psi the heating element restarts. The boiler continues to cycle to maintain 80 psi. If the steam pressure rises to 90 psi, the limit switch shuts off the boiler. The manual reset on the limit switch must then be reset before the boiler will operate again.

For any additional information on the Honeywell Pressuretrols, refer to the Honeywell product sheet in the back of this manual.

12. After filling the boiler and setting the controls, turn the boiler switch to the ON position. Note: The boiler will not start until the manual reset buttons for low water and the steam limit are reset. Boiler should now energize.

13. Boil-out recommendations for new Lattner boilers

With proper operation and maintenance you can expect years of trouble free service from your new Lattner boiler. The procedure for correct operation and care of your unit is not complicated, nor is it time consuming. In this bulletin, we outline the proper boil-out procedure for you boiler prior to placing it into service.

If is necessary to clean the inside of the new boiler of oil and grease used as tube rolling lubricants, threading, and/or other various reasons beyond the manufacturer's control. Since these coatings may lower the heat transfer rate of the heating surfaces, failure to remove these coatings will result in your unit foaming, priming, carry-over or other damage. The boil-out operation is easily accomplished by following the procedure as outlined below:

13.1. Fill the boiler to the normal water line.

13.2. Close boiler steam stop valve in the steam line.

13.3. Remove safety valves at the top of the boiler. The safety valves must be removed to prevent any contaminants or boil-out solution from entering them.

13.4. Tri-sodium phosphate and caustic soda each in the amount of one pound per 50 gallons of water are the suggested chemicals for cleaning boilers. Dissolve these compounds in water and add dissolved chemicals through an opening at the top of the boiler.

NOTE: When dissolving and mixing the boil-out chemicals, the use of a suitable face mask, goggles, rubber gloves, and protective clothing is mandatory. DO NOT permit the dry chemicals or the concentrated solution to come in contact with skin or clothing.

13.5. After adding the boil-out solution, add water to the boiler until it is completely filled.

13.6. Operate the boiler intermittently for 1 hour. Maintain just enough heat to hold the solution at the boiling point. Be patient.

13.7. Continue the process until the overflow water appears clear.

13.8. Stop the heating element and allow the water to cool to about 120°F. Drain the boiler while the water is still warm.

NOTE: Prior to draining the boiler, check with local water treatment facilities to determine whether special instructions or permits are requirea to dispose of the water.

Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

13.9. After closing the openings and reinstalling the safety valves, fill the boiler to its normal water level and fire it until the water temperature is at least 180°F to drive off any dissolves gasses and oxygen which might otherwise corrode the metal.

On a steam system, the condensate should be wasted until test show the elimination of undesirable impurities. During the period the condensate is wasted, attention must be given to the treatment of the raw water used as make up so that an accumulation of unwanted materials or corrosion does not occur. Follow the advice of your water treatment company.

14. Water Quality Limits for Lattner Steam Boilers

Constituent	Recommended Value or Limit
Oxygen	0 parts per million
Carbon Dioxide	0 parts per million
pH	9.0 to 10.0
Total Hardness	_1 parts per million as $CaCO_3$
Total Alkalinit	600 parts per million as $CaCO_3$
Total Dissolved Solids	2200 to 2500 parts per million
Total Iron	<0.1 parts per million
S ecific Conductance	3500 umho/cm non-neutralized
Silica	<150 parts per million
Oil Matter	<0.1 parts per million

Lattner Boiler Company
1411 9th St. SW
Cedar Rapids, IA 52404
Telephone: (800) 345-1527
Fax: (319) 366-0770
Web: www.lattnerboiler.com

Appendix C
Electric System Startup

Technical Memorandum on

Breaker Settings, Fuse Specifications, and Turn-On Procedure *for* C-400 Steam Injection Treatability Study at Paducah, KY

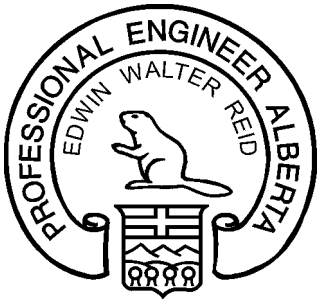
Issued by **McMillan-McGee Corp.**

Submitted to **David Rowntree, P.E., P.Eng.**

Project №: **Arc-Flash Hazard Assessment *for* LATA**

Prepared by **Edwin Walter Reid, Ph.D., P.Eng.**
4895-35B St., S.E.
Calgary, Alberta T2B 3M9
ereid@mcmillan-mcgee.com
403-569-5119

Professional Seal



File Documents>Paducah>Turn-On Procedure for ET-DSP™ C-400 Steam Injection Treatability Study

Date March 12, 2015

Introduction

Based on the single line electrical drawing [1] this document specifies the circuit breaker threshold settings, fuse type and rating for C-400 steam injection equipment located on LATA Environmental Services remediation site at Paducah, KY.

Assumptions and Safety Requirements

(1) The 14.4 kV utility is supplied by an infinite bus.
(2) AB Chance 100 ampere' type K fuse is to be used at the utility feed (primary side of the utility transformer). This is a fast acting fuse.

Circuit Breaker Settings and Fuse Specifications

All circuit breakers and fuses that appear on the single-line drawing [1] are specified below. This will form the basis for the arc flash hazard assessment, which is presented in the next section.

All circuit breakers clearing time setting shall be set for:
(1) A delayed trip of 3.0 seconds should be set when the current reached the interrupt threshold (designated as the 'L' setting on ABB breakers).
(2) 2 cycles clearing time for instantaneous interrupt (designated as the 'I' setting on ABB breakers).
(3) PDP-001 Main Circuit Breaker (following the utility transformer) should be set to a time delayed trip level of 3,000 A; the instantaneous trip current level should be set for 3,300 A.
(4) XFMR-1 circuit breakers should be set for a time delayed trip level of 160 A; the instantaneous trip current level should be set for 176 A.
(5) FD-01 (fused disconnect) should be equipped with a 70 A, type T (slow acting) fuse.

The above clearing times were selected to minimize arc-flash hazard levels throughout the entire system. Because we are supplying current to a predominantly resistive load, these short clearing times should not cause any nuisance interruptions to our delivery of service. The following Table 1 provides settings for the breakers throughout the system. The overload threshold ("L" function) is set at 10% above nominal operating current, with a trip time of 3 seconds. This is to avoid any nuisance trip. Because loads are predominantly resistive, the instantaneous short circuit ("I" function) is set at or 25% above the nominal breaker rating for a trip time not more than two cycles. This is to mitigate arc flash hazard. The selective short circuit setting ("S" function) is turned off, and the earth fault ("G" function) protection is enabled.

The functions "L", "S", "I", and "G" designate <u>overload</u>, <u>selective short circuit</u>, <u>instantaneous short circuit</u>, and <u>earth fault</u> protection, respectively. I_n is the nominal breaker rating. I_1, I_2, and I_3 are trip currents corresponding to the "L", "S", and "I" functions, respectively. And α, β, and ϒ are breaker setting multipliers for the "L", "S", and "I" functions, respectively. The selective short circuit ("S") function is turned off because no temporary inrush current is expected (as for example, starting up electric motors).

Table 1. Breaker Settings

Breaker	L function		S function		I function	G function
parameter unit	I_1 [A]	t_1 [s]	I_2 [A]	t_2 [s]	I_3 [A]	ON/OFF
symbols	$I_1 = (\alpha \times I_n)$	t_1	$I_2 = (\beta \times I_n)$	t_2	$I_3 = (\Upsilon \times I_n)$	
PDP-001 Main Breaker	2400 =(0.80 x 3000)	3.0	OFF		3000 = (1.0 x 3000)	ON
ESB-01A Breaker	1600 =(0.80 x 2000)	3.0	OFF		2500 = (1.25 x 2000)	ON
ESB-01B Breaker	1600 =(0.80 x 2000)	3.0	OFF		2500 = (1.25 x 2000)	ON
XFMR-01 Breaker	128 =(0.80 x 160)	3.0	OFF		200 = (1.25 x 160)	ON

Table 2 provides specifications for the fuses used in the fused disconnections throughout the system. Fuses are of the fast clearing time kind.

Table 2. Fuse Specifications

Fused Disconnect	Rating	Class	Type	Manufacturer
Fused Disconnect on Utility Service Side	100A	K	30003	Chance™
FD-01 for PDC-01	70A	K		

Turn On Procedure

The following procedure should be strictly followed when energizing circuits:

1) Ensure proper personal protective equipment is worn as outlined in reference [2] for the circuits that are being energized.
2) Follow all safety practices as outlined in reference [2]. Do not work alone.
3) Ensure that the utility side of the power service is de-energized. Have the local utility company do this for you.
4) Make sure all breakers and fused disconnects are on the open circuit position.
5) Perform high potential tests on all circuits that are downstream from the utility transformer. All circuits must pass the high potential test. Report any test failures to Edwin Reid and/or David Perley at Mc^2.
6) With all fused disconnects and breakers in the open circuit position, arrange for the local utility company to energize power delivery to the PDS.
7) Wearing Category 2 personal protective equipment as outlined in reference [2], close the main facility breakers on the secondary side of the utility transformer, one at a time. Observe the state of the equipment. Report any problem conditions to Edwin Reid and/or David Perley at Mc^2.
8) Wearing at least Category 0 personal protective equipment as outlined in reference [2], close the PDS breakers, one at a time, and observe the state of the equipment with each breaker closure. Report any

problem conditions to Edwin Reid and/or David Perley at Mc^2.

9) Wearing at least Category 0 personal protective equipment as outlined in reference [2], close the Main Electrode Breakers, one at a time, and observe the state of the equipment with each breaker closure. Report any problem conditions to Edwin Reid and/or David Perley at Mc^2.
10) Observe the state of the equipment and de-energize any circuits that are not working correctly. Report any problem conditions to Edwin Reid and/or David Perley at Mc^2.

Conclusion

This arc flash hazard assessment is based on using Chance type 30003, 100 Amp, class K (fast clearing time) fuse in the fused disconnect on the primary side of the utility transformer. Not using a fast clearing time fuse will elevate the hazard to category 4 on the secondary side of the utility transformers and main PDP breakers. The steps in the procedure should be strictly followed.

References

[1] Single Line Diagram for C-400 Steam Injection Treatability Study, LATA Environmental Services, Paducah
[2] Handbook for Electrical Safety in the Workplace, J.S. Sargent and M. Fontaine, NFPA70E, 2012

Appendix D
Arc Flash Calculations

Technical Memorandum on

Arc-Flash Hazard Assessment *on* C-400 Steam Injection Equipment *for* Treatability Study at Paducah, KY

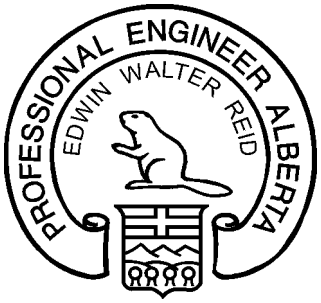
Issued by **McMillan-McGee Corp.**

Submitted to **David Rowntree, P.E., P.Eng.**

Project №: **Arc-Flash Hazard Assessment *for* LATA**

Prepared by **Edwin Walter Reid, Ph.D., P.Eng.**
4895-35B St., S.E.
Calgary, Alberta T2B 3M9
ereid@mcmillan-mcgee.com
403-569-5119

Professional Seal



File Documents>Paducah>Arc Flash Analysis>C-400 Steam Injection Treatability Study

Date March 10, 2015

Introduction

Based on the single line electrical drawing [1] this document addresses safety aspects for operating equipment located on LATA Environmental Services remediation site at Paducah, KY. As such it provides an arc flash hazard assessment, specifies the circuit breaker threshold settings, fuse type and rating, and specifies the level of personal protective equipment that must be worn when operating equipment switchgear.

Assumptions and Remarks

(1) The 14.4 kV utility is supplied by an infinite bus.
(2) Equipment wiring resistance is negligible because cable runs are short.
(3) AB Chance 100 ampere' type K fuse is to be used at the utility feed (primary side of the utility transformer). This is a fast acting fuse.
(4) We do not rely on a circuit breaker to provide full protection since there is risk that a breaker could fail. As such, operating a circuit breaker could expose an operator to flash hazard conditions existing on the upstream circuit.
(5) Arc flash analysis based on an 18 inch (457 mm) working distance.

Assumption (5) should be observed for operator safety. Remark (6) provides PDS operating condition.

Circuit Breaker Settings and Fuse Specifications

All circuit breakers and fuses that appear on the single-line drawing [1] are specified below. This will form the basis for the arc flash hazard assessment, which is presented in the next section.

All circuit breakers clearing time setting shall be set for:
(1) A delayed trip of 3.0 seconds should be set when the current reached the interrupt threshold (designated as the 'L' setting on ABB breakers).
(2) 2 cycles clearing time for instantaneous interrupt (designated as the 'I' setting on ABB breakers).
(3) PDP-001 Main Circuit Breaker (following the utility transformer) should be set to a time delayed trip level of 3,000 A; the instantaneous trip current level should be set for 3,300 A.
(4) XFMR-1 circuit breakers should be set for a time delayed trip level of 160 A; the instantaneous trip current level should be set for 176 A.
(5) FD-01 (fused disconnect) should be equipped with a 70 A, type T (slow acting) fuse.

The above clearing times were selected to minimize arc-flash hazard levels throughout the entire system. Because we are supplying current to a predominantly resistive load, these short clearing times should not cause any nuisance interruptions to our delivery of service. The following Table 1 provides settings for the breakers throughout the system. The overload threshold ("L" function) is set at 10% above nominal operating current, with a trip time of 3 seconds. This is to avoid any nuisance trip. Because loads are predominantly resistive, the instantaneous short circuit ("I" function) is set at or 25% above the nominal breaker rating for a trip time not more than two cycles. This is to mitigate arc flash hazard. The selective short circuit setting ("S" function) is turned off, and the earth fault ("G" function) protection is enabled.

The functions "L", "S", "I", and "G" designate <u>overload</u>, <u>selective short circuit</u>, <u>instantaneous short circuit</u>, and <u>earth fault</u> protection, respectively. I_n is the nominal breaker rating. I_1, I_2, and I_3 are trip currents corresponding to the "L", "S", and "I" functions, respectively. And α, β, and ϒ are breaker setting multipliers for the "L", "S", and "I"

functions, respectively. The selective short circuit ("S") function is turned off because no temporary inrush current is expected (as for example, starting up electric motors).

Table 1. Breaker Settings

Breaker	L function		S function		I function	G function
parameter unit	I_1 [A]	t_1 [s]	I_2 [A]	t_2 [s]	I_3 [A]	ON/OFF
symbols	$I_1 = (\alpha \times I_n)$	t_1	$I_2 = (\beta \times I_n)$	t_2	$I_3 = (\Upsilon \times I_n)$	
PDP-001 Main Breaker	2400 =(0.80 x 3000)	3.0	OFF		3000 = (1.0 x 3000)	ON
ESB-01A Breaker	1600 =(0.80 x 2000)	3.0	OFF		2500 = (1.25 x 2000)	ON
ESB-01B Breaker	1600 =(0.80 x 2000)	3.0	OFF		2500 = (1.25 x 2000)	ON
XFMR-01 Breaker	128 =(0.80 x 160)	3.0	OFF		200 = (1.25 x 160)	ON

Table 2 provides specifications for the fuses used in the fused disconnections throughout the system. Fuses are of the fast clearing time kind.

Table 2. Fuse Specifications

Fused Disconnect	Rating	Class	Type	Manufacturer
Fused Disconnect on Utility Service Side	100A	K	30003	Chance™
FD-01 for PDC-01	70A	K		

Limits of Approach

Using Table 130.4 (C)(a) on page 116 in NFPA70E [2] the approach boundaries to energized electrical conductors or circuit parts for shock protection on a 480 volt system is as follows:

Limited Approach Boundary: 3 feet – 6 inches

Restricted Approach Boundary: 3 feet – 6 inches

Prohibited Approach Boundary: 0 feet – 1 inch

Arc Flash Hazard Assessment

An arc flash hazard analysis on the single line drawing [1] was performed using formulas found on page in 225-241 in NFPA70E [2]. For reference below is a summary of the incident energy range to the hazard category:

Category 0: for incident energy that is less than 4 calories/cm^2.

Category 1: for incident energy more than or equal to 4 calories/cm^2 and less than 8 calories/cm^2.

Category 2: for incident energy more than or equal to 8 calories/cm^2 and less than 25 calories/cm^2.

Category 3: for incident energy more than or equal to 25 calories/cm^2 and less than 40 calories/cm^2.

Category 4: for incident energy greater than or equal to 40 calories/cm^2.

Refer to NFPA70E [2] on pages 155-157 for a detailed list of personal protective equipment to be worn for the above categories.

From the single-line drawing [1] and Mc^2's Arc Fault Calculator [3], the following numbered items identify the potential arc flash hazard locations within the ET-DSP™ equipment:

(1) **Fault on the Facility Main Breaker, and Bus Bar**
This breaker is downstream from the 2500 kVA Utility Transformer.
Bolted Fault Current = 51,756 A
Arcing Current = 24,765 A
Clearing Time = 0.20 seconds
Incident Energy = 17 calories/cm^2 (72 joules/cm^2)
Category 2 PPE must be worn when operating the Facility Main Breaker.
Arc Flash Boundary = 5.1 ft. (61 inches)

(2) **Fault on Breaker ESB-01A**
Bolted Fault Current = 51,765 A
Arcing Current = 24,765 A
Clearing Time = 40 mS (2 cycles at 60 Hz + small time increment)
Incident Energy = 3 calories/cm^2 (14.4 joules/cm^2)
Category 0 PPE must be worn.
Arc Flash Boundary = 2.3 ft. (28 inches)

(3) **Fault on Breaker ESB-01B**
Bolted Fault Current = 51,765 A
Arcing Current = 24,765 A
Clearing Time = 40 mS (2 cycles at 60 Hz + small time increment)
Incident Energy = 3 calorie/cm^2 (14.4 joules/cm^2)
Category 0 PPE must be worn.
Arc Flash Boundary = 2.3 ft. (28 inches)

(4) Operating other breakers that are downstream from Breaker ESB-01 requires that at least Category 0 personal protective equipment be worn.

Procedure

The following procedure should be strictly followed when energizing circuits:

1) Ensure proper personal protective equipment is worn as outlined in reference [2] for the circuits that are being energized.
2) Follow all safety practices as outlined in reference [2]. Do not work alone.
3) Ensure that the utility side of the power service is de-energized. Have the local utility company do this for you.
4) Make sure all breakers and fused disconnects are on the open circuit position.
5) Perform high potential tests on all circuits that are downstream from the utility transformer. All circuits must pass the high potential test. Report any test failures to Edwin Reid and/or David Perley at Mc^2.
6) With all fused disconnects and breakers in the open circuit position, arrange for the local utility company to energize power delivery to the PDS.
7) Wearing Category 2 personal protective equipment as outlined in reference [2], close the main facility breakers on the secondary side of the utility transformer, one at a time. Observe the state of the equipment. Report any problem conditions to Edwin Reid and/or David Perley at Mc^2.
8) Wearing at least Category 0 personal protective equipment as outlined in reference [2], close the PDS breakers, one at a time, and observe the state of the equipment with each breaker closure. Report any problem conditions to Edwin Reid and/or David Perley at Mc^2.
9) Wearing at least Category 0 personal protective equipment as outlined in reference [2], close the Main Electrode Breakers, one at a time, and observe the state of the equipment with each breaker closure. Report any problem conditions to Edwin Reid and/or David Perley at Mc^2.
10) Observe the state of the equipment and de-energize any circuits that are not working correctly. Report any problem conditions to Edwin Reid and/or David Perley at Mc^2.

Conclusion

This arc flash hazard assessment is based on using Chance type 30003, 100 Amp, class K (fast clearing time) fuse in the fused disconnect on the primary side of the utility transformer. Not using a fast clearing time fuse will elevate the hazard to category 4 on the secondary side of the utility transformers and main PDP breakers. The steps in the procedure should be strictly followed.

References

[1] Single Line Diagram for C-400 Steam Injection Treatability Study, LATA Environmental Services, Paducah
[2] Handbook for Electrical Safety in the Workplace, J.S. Sargent and M. Fontaine, NFPA70E, 2012
[3] Matlab™ arc flash program Mar_10_2015B.m, McMillan-McGee Corp.

Appendix A: Results from run of Matlab arc-flash analysis program Mar_09_2015B.m**.**

```
>> Mar_10_2015B
*** ARC-FAULT HAZARD ANALYSIS FOR LATA at Paducah, KY ***
```

*** C-400 STEAM INJECTION TREATABILITY STUDY ***
THIS PROGRAM WAS LAST RUN ON MARCH 10, 2015

---- FAULT ON THE SECONDARY SIDE OF THE FACILITY TRANSFORMER ----
FAULT CURRENT [AMPS] ON THE SECONDARY SIDE OF THE FACILITY TRANSFORMER
THAT INCLUDES THE FEED CABLES AND PDP MAIN BREAKER
51756

Arcing Current [A] on secondary side of facility tansformer

I_arcing_kA =

24.7648

Current [kA] on primary side of facility tansformer due to arcing current on secondary
this is used for selecting the facility transformer fuse

I_pri_Amps =

825.1108

USING 100 AMP TYPE K FAST CLEARING TIME CHANCE 30003 FUSE ON PRIMARY SIDE OF FACILITY TRANSFORMER
ARCING TIME [seconds]

t =

0.2000

INCIDENT ENGERGY [JOULES/CM^2] ON THE SECODARY SIDE OF THE FACILITY TRANSFORMER
72
Arc Flash Boundary [ft]

Dc_ft =

5.1478

INCIDENT ENGERGY [CALORIES/CM^2] ON THE SECONDARY SIDE OF THE FACILITY TRANSFORMER
17
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

---- FAULT ON THE BUS BAR DOWNSTREAM FROM THE PDP MAIN BREAKER ----
FAULT CURRENT [AMPS] ON THE BUS BAR
51756

Arcing Current [A]

```
I_arcing_kA =

   24.7648

PDP MAIN BREAKER SET FOR A CLEARING TIME OF 2 CYCLES = 40 mS
INCIDENT ENGERGY [JOULES/CM^2] DUE TO A FAULT ON THE BUS BAR
 14.37

INCIDENT ENGERGY [CALORIES/CM^2] DUE TO A FAULT ON THE BUS BAR
     3
Arc Flash Boundary [ft]

Dc_ft =

    2.3022



  ----  FAULT ON THE SECONDARY WINDING OF THE XFMR-1 for the LOAD CENTER  ----
FAULT CURRENT [AMPS] ON THE SECONDARY WINDING OF THE LOAD CENTER TRANSFORMER
  1551

Arcing Current [A]

I_arcing_kA =

    1.3333

CLEARING TIME OF 2 CYCLES = 40 mS
INCIDENT ENGERGY [JOULES/CM^2]DUE TO A FAULT AT THE LOAD CENTER TRANSFORMER
  0.61


Arc Flash Boundary [ft]

Dc_ft =

    0.2522

INCIDENT ENGERGY [CALORIES/CM^2] DUE TO A FUALT AT THE LOAD CENTER TRANSFORMER
     0
```

Appendix B: Matlab arc-flash analysis program Mar_10_2015B.m**.**

```
% Mar_10_2015B
```

```
% Ref:  Jan_14_2015B
% Ref:  Jan_13_2015
% ref:  Oct_21_2014
% ref:  Jan_9_2014

disp('*** ARC-FAULT HAZARD ANALYSIS FOR LATA at Paducah, KY ***')
disp('*** C-400 STEAM INJECTION TREATABILITY STUDY  ***')
disp('THIS PROGRAM WAS LAST RUN ON MARCH 10, 2015')
disp('')
% Arc Flash Analysis
% Single Line Drawing of a DELTA - WYE Three-Phase Circuit
% Note: The symbol "<>" indicates data is required.

clear all
disp('     ')
disp('     ')
% Base System for Defining the Per_Unit Quantities
S_base = 2500; % [kVA] facility XFMR delta pri, wye sec.   <1500 1500>
V_base = .480; % [kV] secondary voltage of facility XFMR.  <>

% Incident Energy Parameters (note selection options)

%  Choose one of the two K's below (taken from Eq. D.7.2(a) pg.233)
% K = -0.153; % open air arcs
 K = -0.097; % arcs-in-a-box <>

% Choose one the the three G's bleow (taken from Table D.7.2 pg.234)
% G = 10; % [mm] 10 to 40 [mm] arcs in open air up to 1 kV
G = 32; % [mm] Switchgear <>
% G = 25; % MCC's and Panel
% G = 13; % Cables

% Choose one of the two k1's below (taken from Eq. D.7.3(a) pg.234)
% k1 = -0.792; % open air arcs
 k1 = -0.555; % arcs-in-a-box   <>

% Choose one of the two k2's below (taken from Eq. D.7.3(a) pg.234)
% k2 = 0.0; % ungrounded and high resistance ground systems
k2 = -0.113; % grounded systems   <>

%%t = 0.2; % [sec] arcing time
D = 457; % [mm] distance from arc to person 610 mm is normally given

Cf = 1.5; % for systems less than 1 kV

% Distance Exponent Factor x (Table D.7.2 pg.234)
% x = 2.000; % arcs in open air up to 1 kV
x = 1.473; % Switchgear <>
% x = 1.641; % MCC's and Panel
% x = 2.000; % Cables
```

```
% ~~~ end of incident engergy parameters ~~~ %



disp('----     FAULT ON THE SECONDARY SIDE OF THE FACILITY TRANSFORMER   ----
')

Z_fac_XFMR = 5.81; % [%] %Z of the facility XFMR. < %Z = 5.5 WORST CASE >
V_sec_fac = 0.480; % [kV] sec voltage of facility XFMR.  <>
I_fault_fac_XFMR = S_base*( 100/(Z_fac_XFMR) )/(V_sec_fac*sqrt(3)); % fault
current fac XFMR, Y-connected
% RESULT
I_fault_fac_XFMR_AMPS = I_fault_fac_XFMR;
disp('FAULT CURRENT [AMPS] ON THE SECONDARY SIDE OF THE FACILITY
TRANSFORMER')
disp('THAT INCLUDES THE FEED CABLES AND PDP MAIN BREAKER')
fprintf('%6.0f\n',I_fault_fac_XFMR_AMPS);
disp('     ')
% Arcing Current
LIa = K + 0.662*log10(I_fault_fac_XFMR/1000) + 0.0966*(V_sec_fac) +
0.000526*G + 0.5588*(V_sec_fac)*log10(I_fault_fac_XFMR/1000) -
0.00304*G*log10(I_fault_fac_XFMR/1000);
Ia = 10^LIa; % [kA] arcing current
disp('Arcing Current [A] on secondary side of facility tansformer')
I_arcing_kA = Ia
disp('   ')
disp('   ')
disp('Current [kA] on primary side of facility tansformer due to arcing
current on secondary')
disp(' this is used for selecting the facility transformer fuse ')
I_pri_Amps = sqrt(3)*277/14400*Ia*1000

% Normalized Incident Energy
LEn = k1 + k2 + 1.081*log10(Ia) + 0.0011*G;
En = 10^LEn; % [Joules/cm^2] Normalized Incident Engergy
% Converting from Normalized to a Working System
disp('USING 100 AMP TYPE K FAST CLEARING TIME CHANCE 30003 FUSE ON PRIMARY
SIDE OF FACILITY TRANSFORMER')
disp('ARCING TIME [seconds]')
t = 0.20 % [sec]  arcing time worst case recommended in NFPA70E   <0.20,
0.20>
E = 4.184*Cf*En*(t/0.2)*(610/D)^x; % [Joules/cm^2] Actual Incident Engergy
disp('INCIDENT ENGERGY [JOULES/CM^2] ON THE SECODARY SIDE OF THE FACILITY
TRANSFORMER')
fprintf('%6.0f\n',E);
Dc_ft = sqrt(53*S_base/1000*t);
disp('Arc Flash Boundary [ft]')
Dc_ft
disp('     ')
disp('     ')
E_cal = E*0.2390; % converting from Joules/cm/cm to Calories/cm/cm
disp('INCIDENT ENGERGY [CALORIES/CM^2] ON THE SECONDARY SIDE OF THE FACILITY
TRANSFORMER')
```

```
fprintf('%6.0f\n',E_cal);


disp(' *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ')
disp('   ')
disp(' ----  FAULT ON THE BUS BAR DOWNSTREAM FROM THE PDP MAIN BREAKER  ----
')

I_fault_Bus_Bar = S_base*( 100/(Z_fac_XFMR) )/(V_sec_fac*sqrt(3)); %

%  RESULT
I_fault_Bus_Bar_AMPS = I_fault_Bus_Bar;
disp('FAULT CURRENT [AMPS] ON THE BUS BAR')
fprintf('%6.0f\n',I_fault_Bus_Bar_AMPS);
disp('     ')
% Arcing Current
LIa = K + 0.662*log10(I_fault_Bus_Bar/1000) + 0.0966*(V_sec_fac) + 0.000526*G
+ 0.5588*(V_sec_fac)*log10(I_fault_Bus_Bar/1000) -
0.00304*G*log10(I_fault_Bus_Bar/1000);
Ia = 10^LIa; % [kA] arcing current
disp('Arcing Current [A]')
I_arcing_kA = Ia
% Normalized Incident Energy
LEn = k1 + k2 + 1.081*log10(Ia) + 0.0011*G;
En = 10^LEn; % [Joules/cm^2] Normalized Incident Engergy
% Converting from Normalized to a Working System
disp('PDP MAIN BREAKER SET FOR A CLEARING TIME OF 2 CYCLES = 40 mS')
t = 40.00/1000; % [sec]  fault clears in 2 cycles <>  <-------------------
E = 4.184*Cf*En*(t/0.2)*(610/D)^x; % [Joules/cm^2] Actual Incident Engergy
disp('INCIDENT ENGERGY [JOULES/CM^2] DUE TO A FAULT ON THE BUS BAR')
fprintf('%6.2f\n',E);
disp('     ')
E_cal = E*0.2390; % converting from Joules/cm/cm to Calories/cm/cm
disp('INCIDENT ENGERGY [CALORIES/CM^2] DUE TO A FAULT ON THE BUS BAR')
fprintf('%6.0f\n',E_cal);
Dc_ft = sqrt(53*S_base/1000*t);
disp('Arc Flash Boundary [ft]')
Dc_ft
disp('     ')
disp('     ')

disp('     ')
disp('  ----  FAULT ON THE SECONDARY WINDING OF THE XFMR-1 for the LOAD
CENTER  ----')

S_pds = 30; % [kVA] PDS XFMR delta pri, wye sec.  <>
V_pds = 0.208; % [kV] secondary winding of PDS XFMR  <>
Z_pds = 5.3; % [%] %Z ref to pri wdg on PDS XFMR     <>
Z_pds_ref_base = Z_pds*(S_base/S_pds); % [%] %Z of PDS XFMR referred to base
I_fault_pds = S_base*( 100/(Z_fac_XFMR + Z_pds_ref_base) )/(V_pds*sqrt(3)); %
% RESULT
I_fault_pds_AMPS = I_fault_pds;
```

```
disp('FAULT CURRENT [AMPS] ON THE SECONDARY WINDING OF THE LOAD CENTER
TRANSFORMER')
fprintf('%6.0f\n',I_fault_pds_AMPS);
disp('     ')
% Arcing Current
LIa = K + 0.662*log10(I_fault_pds/1000) + 0.0966*(V_sec_fac) + 0.000526*G +
0.5588*(V_sec_fac)*log10(I_fault_pds/1000) -
0.00304*G*log10(I_fault_pds/1000);
Ia = 10^LIa; % [kA] arcing current
disp('Arcing Current [A]')
I_arcing_kA = Ia

% Normalized Incident Energy
LEn = k1 + k2 + 1.081*log10(Ia) + 0.0011*G;
En = 10^LEn; % [Joules/cm^2] Normalized Incident Engergy
% Converting from Normalized to a Working System
disp('CLEARING TIME OF 2 CYCLES = 40 mS')
t = 40.00/1000; % [sec]  fault clears in 2 cycles  <> <------------------
E = 4.184*Cf*En*(t/0.2)*(610/D)^x; % [Joules/cm^2] Actual Incident Engergy
disp('INCIDENT ENGERGY [JOULES/CM^2]DUE TO A FAULT AT THE LOAD CENTER
TRANSFORMER')
fprintf('%6.2f\n',E);
disp( '  ');
disp('   ');
Dc_ft = sqrt(53*S_pds/1000*t);
disp('Arc Flash Boundary [ft]')
Dc_ft
E_cal = E*0.2390; % converting from Joules/cm/cm to Calories/cm/cm
disp('INCIDENT ENGERGY [CALORIES/CM^2] DUE TO A FUALT AT THE LOAD CENTER
TRANSFORMER')
fprintf('%6.0f\n',E_cal);
disp('     ')
disp('     ')
```

Appendix E
Temperature Monitoring System Startup

Paducah Gaseous Diffusion Plant

C-400 Remediation Area

Temperature Monitoring Computer System

Acronyms and terms used:

TDAM – Thermocouple Data Acquisition Module

DAQ – Data Acquisition

ICP DAS – Corporate Partner that provides most of the Data Acquisition equipment

RS-485/Modbus – Serial Data Network and Protocol that carries temperature, flow and energy data

HMI – Human-Machine Interface

The PDGP Temperature Monitoring system consists of the following components:

1. TMP well type K thermocouple strands (about 21 elements per well location)
2. ICP DAS M-7008 Analog to Digital converter units (TDAM) (3 per well location)
3. TDAM Enclosure (one per well location)
4. TDAM network (RS-485 Modbus) wiring
5. Energy/Power Meter to Modbus
6. Steam Flow Meters with Modbus data capability
7. Modbus-to-Ethernet Converter
8. DAQ Computer with database and HMI for operator use, and reporting output

Background:

The TMP wells each incorporate a series of temperature monitoring points, which are digitally captured and distributed along a serial network to the DAQ computer for recording and display. The entire system needs continuous power to perform the temperature reading, transmission and recording. Located in the field office, is the HMI computer, which will provide real-time graphs and historical recording of the temperature data.

Start-up Procedure:

The HMI computer must be powered on, and recording. The 120VAC to 24VDC power supply must be on, and providing power to all the TDAMs, Modbus-to-Ethernet module, Flow Meters and Energy Meter. The TDAMs are located inside protective NEMA-4 enclosures inside or near the well heads. The TDAM enclosures must be protected from moisture and dust, as they contain sensitive electronics inside.

The HMI computer will run the HMI and database recording by default. If the computer is powered down for any reason, restarting the computer will automatically run the HMI and data recording.

As long as the TDAM network is powered and communicating properly, the TMP data will be displayed and stored.

Faults in the data will likely be caused by a data location (well or metering unit) not powered on properly. The TDAM locations contain a replaceable .5A AGC fuse in case of accidental moisture or other elemental issue, causing a trip.

Data should be monitored continuously on the HMI, or at least spot-checked often to detect signs of trouble. This system is NOT equipped with remote access of any kind, to facilitate cell-phone or e-mail based alarm/alerting.

Issues with the HMI computer, TMP/Modbus network or any of the meters should be directed ASAP to ERM.

Appendix F
Steam Injection System Startup

Table of Contents

Section	Title	Page
1.0	Introduction	3
1.1	Purpose	3
1.2	Scope	3
1.3	Background	3
2.0	Terms/Definitions	3
3.0	Responsibilities	4
4.0	Records	4
5.0	Precautions	4
6.0	Prerequisite Actions	5
7.0	Performance Checklists	5
7.1	Steam Injection Emergency Shutdown	5
7.2	Steam Injection Complete Startup	6
7.3	Steam Injection Complete Shutdown	9
7.4	Steam Injection Partial Shutdown	10
7.5	Steam Injection Re-Start	11

Attachments

Attachment 1 – Steam Injection Pre-Start Valve Alignment Checklist	14
Attachment 2 – Steam Injection Normal Valve Alignment Checklist	15
Attachment 3 – Steam Injection Shutdown Valve Alignment Checklist	16

1.0 Introduction

1.1 Purpose

This document provides detailed steps for the initial startup of the C-400 Phase IIb Steam Injection Treatability Study (TS) Paducah, Kentucky (LKY-SC-036) steam injection system, for subsequent system startups, and for safely operating the system.

1.2 Scope

This procedure includes instructions for:

- Notifying key personnel in advance of system changes,
- Safely warming up steam injection piping,
- Injecting steam into subsurface sediments under normal conditions,
- Shutting off the steam injection system completely,
- Shutting off the steam injection system partially (while maintaining steam supply to certain components),
- Shutting off the steam injection system under emergency conditions (including emergency shutdown checklist),

1.3 Background

The TS will inject steam at depth intervals of 70 to 75 ft (shallow well) and 95 to 100 ft (deep well) below ground surface (bgs). Each well will receive up to 3,000 lbs./hr. saturated steam at approximately 40 psig. As with any steam distribution system, startup is the most critical phase of operation. The requirements of this procedure must be followed to prevent catastrophic accidents caused by water hammer or thermal shock. The effects of water hammer can be prevented or minimized by an adequate warm-up and blowdown of the steam lines during startup. Whenever operation of the steam injection system is changed (increasing or decreasing steam requirements), it is important that all affected personnel are notified and the changes are slow and controlled.

2.0 Terms/Definitions

Drip Leg – Installed at low points within the steam distribution system, each equipped with a single steam trap which discharges condensate, and a larger capacity free-blow line for warming or draining the steam distribution pipeline.

Free-Blow – Steam branch within drip leg, adjacent to steam traps, for discharging condensate from steam lines during warm up, when the steam condensation rate exceeds the normal trap discharge rate. Isolation valve D is opened to discharge steam (wet or dry) and hot condensate.

Pressure Regulating Valve (PRV) – Self-actuated pilot operated pressure regulator that controls steam pressure to the steam injection wells. Steam is supplied to the shallow and deep pressure reducing stations (PRV-110S and PRV-110D) at up to 140 psig and reduced to 40 psig before injection.

Steam Trap – A device used to automatically remove condensate from a saturated steam system. During normal operation the steam trap will discharge small amounts of condensate continuously or bursts of condensate intermittently. The steam traps have integral strainers to remove debris that could damage the trap. Isolation valves A and B allow taking the trap out of

service during startups and shutdowns. A maintenance line with isolation valve C allows venting between the two isolation valves to monitor for leakage.

Steam Trap Isolation Drain – Bleed valve located between the double isolation valves for isolating steam traps from condensate flow. Allows debris to flow from steam piping during initial startup, without entering steam trap strainers.

Water Hammer – Loud banging noise usually accompanied by movement in piping resulting from water in steam lines during startup. Water hammer is caused 1) by the flashing of water into steam when superheated steam flows through a pipeline with pockets of water, 2) when water condenses steam creating a vacuum in the line causing water to rapidly fill the void, and 3) by physical shock that occurs when water is carried along with steam or pushed ahead of steam. Water can impact steam line components and piping bends, which will cause a shock within the system. Significant structural damage can occur if water hammer is not mitigated.

3.0 Responsibilities

The **Steam Injection Operator** is responsible for:

A) Performing this procedure and documenting completion,
B) Following all applicable PGDP procedures,
C) Notifying the Project Manager and the Site Technical Representative (STR) of any significant changes in the status of the steam injection system and any abnormal conditions encountered during startup and operation.

4.0 Records

A chronology of activities shall be recorded in an Operations Log, which shall remain at the site for the duration of the project.

5.0 Precautions/Safety

A) **Safety gloves** (dry leather), **safety glasses, hard hats with attached face shield in place, full-length sleeve flame-resistant (FR) coveralls,** and **hearing protection** are required when operating high-pressure steam systems to prevent personal injury.

B) **Establish communications** between the Steam Injection Operator and other personnel participating in the performance of this procedure.

C) **Avoid contact with hot steam line components**.

CAUTION: To protect personnel from dry steam discharge, only trained, experienced personnel will be allowed in restricted areas. A restricted area will be established using the jersey barriers along Tennessee Avenue and/or other approved barriers to restricte access within 25 feet of the steam piping system and boiler.

D) **Avoid contact with condensate drips or pools of hot condensate** around free-blows or steam trap drains.

E) **Report any abnormal conditions** to the Project Manager.

F) All steam line components shall be **operated slowly** to allow adequate system reaction time and adequate observation time.

G) **Always be alert for symptoms of water hammer** (i.e. loud knocking inside a steam line and/or excessive movement of the steam line) and perform remedial actions as outlined within this procedure.

H) Water hammer or vibration may occur when opening any steam isolation valve if condensate is present in the steam piping**. If excessive water hammering or vibration is observed, immediately close the steam isolation valve** and then verify all upstream drains and/or free-blow valves are open and discharging condensate. The Project Manager shall be notified immediately if damage occurs. Do not reopen the steam isolation valve until the cause of the water hammer is determined and eliminated.

I) **Inspect the steam distribution pipelines continuously for signs of leakage or abnormal conditions as the system is being pressurized and placed in service**.

6.0 Prerequisite Actions

6.1 Determine which section of this procedure will be performed and for what reason, and record in Operations Log:

- Section 7.2, Steam Injection Complete Startup – starts with the steam distribution pipelines out of service, and ends with the steam distribution pipelines in service.
- Section 7.3, Steam Injection Complete Shutdown – starts with the steam distribution pipelines in service, and ends with all systems isolated from the steam boiler and depressurized.
- Section 7.4, Steam Injection Partial Shutdown – starts with both shallow and deep steam injection pipelines in service, and ends with one steam injection pipeline in service and the other steam injection pipeline or well out of service.
- Section 7.5, Steam Injection Re-Start – starts with one steam injection pipeline in service, and ends with the other steam injection pipeline or well in service.

6.2 Notify the Project Manager and STR prior to performing this procedure.

6.3 Ensure the procedure is an approved working copy of the current revision.

6.4 Ensure that Sections 5.0 and 7.1, Precautions/Safety and Emergency Shutdown Procedures, have been reviewed prior to starting any section.

7.0 Performance Checklists

Sections 7.1 through 7.7 cover different aspects of operating the steam system.

7.1 Steam Injection Emergency Shutdown

NOTE: Because of its importance, for quick access by operators or other project personnel using this procedure, this section is presented ahead of all sections pertaining to steam injection startup.

7.1.1 IF UNSAFE CONDITIONS EXIST AND IMMEDIATE ACTION IS REQUIRED TO PREVENT INJURY OR DAMAGE, OR THERE IS ANY UNCERTAINTY:

SHUT DOWN THE STEAM BOILER ESB-01

NOTE: If the problem can be identified, the Steam Injection Operator may elect to correct the problem without turning off the steam boiler. Additionally, in some situations, the Steam Injection Operator may elect to isolate only certain sections of the steam distribution system if those sections are determined to be the only sections with unsafe conditions. If the Steam Injection Operator is uncertain as to which steam distribution branches can be safely isolated to correct an unsafe condition, while maintaining steam supply to those components and branches that are determined to be operating safely, the Steam Injection Operator should isolate all steam by closing the main steam supply isolation valves (HV-100 or HV-105, and the bypass CV-106).

ALWAYS, IF IN DOUBT, SHUT DOWN THE STEAM BOILER ESB-01

CAUTION: At high steam flowrates, the steam boiler may trip on high feedwater level or its safety valve may open if shutdown is too rapid.

7.1.2 If an emergency shutdown is performed with the steam distribution lines pressurized, immediately throttle open all free-blow and drain valves approximately one-turn every 5 to 10 minutes to depressurize the pipeline.

7.1.3 In the event an automatic shutdown of the steam injection system has occurred, the steam system must be placed in a safe condition and the cause evaluated prior to restart:

- 7.1.3.1 **CLOSE** HV-100 and/or HV-105/CV-106.
- 7.1.3.2 Review site conditions to ascertain the cause of the automatic shutdown. Once the cause is determined, take actions to correct the problem.
- 7.1.3.3 Inform the Project Manager and STR of the automatic shutdown, the root cause, and the corrective actions taken. Re-start of the steam injection system shall not occur until authorization has been received from the Project Manager and STR.

7.1.4 Record abnormal conditions observed and corrective actions taken, in the Operations Log.

7.2 Steam Injection Complete Startup – Perform these steps if the steam pipelines are out of service with the steam boiler already started up per Appendix A.

NOTE: For **initial system startup** and subsequent system startup after prolonged shut-down periods, steam traps shall be isolated from condensate flow by use of each steam trap's isolation valves, which allows debris in pipelines to flow out the isolation drain. During system re-starts after brief shutdown periods, steam traps may remain in service, in addition to opening free-blow valves, for draining condensate during system warm-up.

NOTE: If symptoms of water hammer are observed while opening a steam isolation valve, closing the isolation valve will eliminate flow of energy to the steam distribution system and stop the water hammer.

CAUTION: The following steps shall be performed in the event water hammer symptoms occur anytime during system startup.

7.2.1 If excessive water hammer occurs during warm-up of any sections of the steam distribution pipelines:

- 7.2.1.1 Immediately **CLOSE** the closest upstream valves to isolate steam from the sections experiencing water hammer.
- 7.2.1.2 If uncertain as to which piping sections may be experiencing excessive water hammer, **CLOSE HV-100 or HV-105/CV-106** to isolate steam from the steam

distribution system.

7.2.1.3 **OPEN** steam trap free-blow valves to depressurize and drain the affected sections that are isolated.

7.2.1.4 Record corrective actions in the Operations Log.

7.2.1.5 Notify the Project Manager and STR of abnormal conditions, and record person contacted and time of contact, in the Operations Log.

7.2.1.6 Suspend further warm-up operation until supervision has determined the proper corrective actions.

7.2.1.7 Resume system warm-up only after approval from the Project Manager and STR.

7.2.2 Perform Steam Injection Pre-Start Valve Alignment Checklist (Attachment 1) to identify and reposition valves to the desired pre-start position.

NOTE: Individual valves or components that cannot be aligned according to the requirements of this procedure as described in Attachment 1 ("Steam Injection Pre-Start Valve Alignment Checklist") should be annotated as deviations by placing a (N) in the Yes/No column next to the component on the checklist.

7.2.3 Ensure CLOSED steam isolation valves HV-105/CV-106 to isolate the steam piping from the steam boiler.

NOTE: Allow sufficient time for proper warm-up and blow-down (condensate removal) of the steam distribution system. This is the most critical part of starting up any steam system and shall never be expedited for the sake of time constraints.

7.2.4 In Operations Log, record:

7.2.4.1 Commencement of steam distribution pipeline warmup.

7.2.4.2 Steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.

7.2.4.3 Initial position of steam injection well hoses.

7.2.4.4 Completion of Attachment 1.

7.2.5 Ensure all drip legs are in STARTUP service:

7.2.5.1 **CLOSE** valves A and B to isolate the steam trap (to prevent debris from clogging the internal strainer).

7.2.5.2 **CLOSE** valve C.

7.2.5.3 **Throttle OPEN** free-blow valve D approximately two turns.

NOTE: All free-blow and drain valves were partially opened as instructed in the Steam Injection Pre-Start Valve Alignment Checklist (Attachment 1). As the steam distribution piping warms, the free-blows and drains will eventually discharge dry steam, at which time the steam traps can be placed into service and the free-blow and drain valves closed. Free-blows and drains closer to the steam boiler will warm first, and will need to be closed sooner than more distant free-blows and drains.

CAUTION: Cold/hot condensate and eventually wet/dry steam will discharge from the free-blow and drain valves. Ensure all personnel are aware that start-up is in progress and areas around free-blows and drains are properly secured to prevent unauthorized access.

7.2.6 Verify OPEN steam boiler isolation valve HV-100. If closed:

7.2.6.1 Slowly **throttle OPEN** HV-100 approximately one-half turn to one-turn every 15 to 30 minutes.

7.2.6.2 Monitor steam and/or condensate discharging from the free-blow valve D. If additional condensate needs to be removed, slowly **throttle OPEN** free-blow

valve D in one-half turn increments while opening HV-100.

7.2.6.3 Monitor steam distribution pipeline pressure on PG-100.

7.2.6.4 When HV-100 FULLY OPEN and only dry steam is discharging from the free-blow valve, place steam trap between HV-100 and HV-105 in service:

7.2.6.4.1 **Throttle CLOSE** valve D to approximately one-half turn open.

7.2.6.4.2 **OPEN** valves A and B.

7.2.6.4.3 Verify the steam trap is working properly, as evidenced by occasional bursts of hot condensate.

7.2.6.4.4 **Fully CLOSE** valve D.

7.2.6.5 Proceed to next step only after HV-100 is fully open and its downstream steam trap is in service.

7.2.7 Verify CLOSED steam well throttle valves CV-115S2 and CV-115D2 to prevent injecting steam into the wells.

7.2.8 **Throttle OPEN** CV-115S1 and SV-115D1 approximately one-turn to allow condensate to drain into the wells.

7.2.9 **Throttle OPEN CV-106**, the bypass for HV-105, approximately one-half to one-turn to commence steam flow into the steam distribution pipeline.

7.2.10 Monitor thermal expansion pipe growth and **STOP** warmup if excessive growth occurs where pipeline becomes restricted or exceeds flexible hose lateral limit (3 inch).

7.2.11 Monitor steam and/or condensate discharging from all open free-blow and drain valves.

NOTE: Continuously monitor for indications of water hammer.

7.2.12 As the steam distribution system warms, continue to **throttle OPEN** free-blow and drain valves in one-half to one-turn increments, as needed, to discharge hot condensate and/or wet steam.

7.2.13 Monitor steam pressure build-up on PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.

CAUTION: Do not continue to open CV-106 if pressure regulators PRV-110S and PRV-110D cannot control steam pressure at setpoint. Investigate reason regulator(s) is not functioning before proceeding further.

7.2.14 Continue to **slowly throttle OPEN CV-106** approximately one-half to one-turn every 15 to 30 minutes, while observing water/wet steam discharge from the free blow and drain valves.

7.2.15 When steam pressure on PG-110S and PG-110D reaches PRV-110S and PRV-110D setpoints, verify PRV-110S and PRV-110D regulating downstream pressure at setpoint.

7.2.16 Continue to **slowly THROTTLE OPEN CV-106** approximately one-half to one-turn every 15 to 30 minutes, while observing water/wet steam discharge from the free blow and drain valves.

7.2.17 When CV-106 is FULLY OPEN, record steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.

7.2.18 **Fully OPEN** HV-105, and **CLOSE** CV-106.

7.2.19 When HV-105 FULLY OPEN and only dry steam is discharging from the free-blow valve, place steam traps in service:
7.2.19.1 **Throttle CLOSE** valve D to approximately one-half turn open.
7.2.19.2 **OPEN** valves A and B.
7.2.19.3 Verify the steam trap is working properly, as evidenced by occasional bursts of hot condensate.
7.2.19.4 **Fully CLOSE** valve D.

7.2.20 **CLOSE** all steam trap free-blow D and drain valves.

7.2.21 In Operations Log, record:
7.2.21.1 Completion of steam distribution pipeline warmup.
7.2.21.2 Steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.
7.2.21.3 Final expansion position of steam injection well hoses.

7.2.22 Inform the Project Manager and STR that steam distribution piping warmup has been completed.

7.2.23 If desired to commence steam injection into the shallow or deep well, obtain permission from the Project Manager and STR. Otherwise, proceed to step 7.2.27.

7.2.24 **Slowly throttle OPEN** CV-115S1 and CV-115D1 approximately one-turn every 15 to 30 minutes.

7.2.25 When CV-115S1 and CV-115D1 fully open, **throttle OPEN** CV-115S2 and CV-115D2 one-half turn to maintain steam injection pipelines in service.

7.2.26 Obtain Project Manager and STR permission to inject steam into the shallow and deep steam injection wells at the approved rates and schedule.

7.2.27 **CLOSE** steam injection bypass valves CV-115S1 and CV-115D1.

7.3 Steam Injection Complete Shutdown – Perform this section to normally shutdown and depressurize the in service steam distribution pipeline.

NOTE: This section refers to shutdowns for prolonged periods without steam injection into the ground. The Steam Injection Operator may choose to perform a partial shutdown, keeping certain components of the steam distribution system hot, by maintaining steam pressure and flow to those components. In that case, refer to Section 7.4 for partial shutdown instructions.

NOTE: The steam distribution piping shall be slowly depressurized to prevent tripping the steam boiler and/or opening the safety valve.

7.3.1 Obtain permission from the Project Manager and STR to normally shutdown and depressurize the steam distribution piping.

7.3.2 Record commencement of steam distribution pipeline shutdown and depressurization in the Operations Log along with all steam parameters on PG-100, PG-110S, PG-110D, ET-100S, and ET-100D.

7.3.3 **Slowly CLOSE** steam well isolation valves CV-115S1, CV-115S2, CV-115D1, and CV-115D2, while monitoring and maintaining steam boiler operation.

7.3.4 **CLOSE** all steam trap isolation valves A and B.

CAUTION: Dry steam will discharge from the free-blow and drain valves. Dry steam is very difficult to see. Ensure all personnel are aware that start-up is in progress and Ensure areas around free-blows and drains are properly secured to prevent unauthorized access.

7.3.5 **Throttle OPEN** free-blow valves D and drain valves approximately one-turn.

7.3.6 **Slowly throttle CLOSE** either HV-100 (if steam is to be isolated at the steam boiler) or HV-105 (if steam to be isolated at the main header) approximately one-turn every 5 to 15 minutes, while monitoring and maintaining steam boiler operation.

7.3.7 Monitor all steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D to verify steam distribution piping depressurizing and draining at all locations.

7.3.8 After HV-100 or HV-105 fully closed, **slowly throttle OPEN** free-blow and drain valves approximately one-half to one-turn every 15 to 30 minutes, while observing dry steam discharge from the free blow and drain valves.

7.3.9 Continue depressurizing steam distribution pipeline until steam pressure at 0 psig on PG-100, PG-110S, and PG-110D. Proceed to next step once this has been achieved.

7.3.10 Review Steam Injection Shut-Down Valve Alignment Checklist (Attachment 3) to identify and reposition components in other than normal positions (Attachment 2).

7.3.11 In Operations Log, record:
7.3.11.1 Completion of steam distribution pipeline shutdown (at HV-100 or HV-105).
7.3.11.2 Steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.
7.3.11.3 Final cold position of steam injection well hoses.
7.3.11.4 Completion of Attachment 3.

7.3.12 Inform the Project Manager and STR that steam distribution piping shutdown and depressurization has been completed.

7.4 **Steam Injection Partial Shutdown –** Perform this section to shut down one of the injection pipelines or wells while maintaining the other injection pipeline in service.

NOTE: The steam injection piping shall be slowly depressurized to prevent tripping the steam boiler and/or opening the safety valve.

7.4.1 Determine which steam injection pipeline and/or well will be taken out of service.

7.4.2 Obtain permission from the Project Manager and STR to normally shutdown and depressurize the specified shallow or deep steam injection pipeline.

7.4.3 Record commencement of steam injection pipeline shutdown and depressurization in the Operations Log along with all steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.

7.4.4 **Slowly CLOSE** steam well isolation valves CV-115S1 and CV-115S2 (shallow injection) or CV-115D1 and CV-115D2 (deep injection), while monitoring and maintaining steam boiler operation.

7.4.5 If intent is to only shutdown steam to one of the injection wells, bypass the remaining steps and proceed to step 7.4.13.

7.4.6 **CLOSE** all steam trap isolation valves A and B in the injection line to be shutdown.

CAUTION: Dry steam will discharge from the free-blow and drain valves. Dry steam is very difficult to see. Ensure all personnel are aware that start-up is in progress and Ensure areas around free-blows and drains are properly secured to prevent unauthorized access.

7.4.7 **Throttle OPEN** free-blow valves D and drain valves approximately one-turn in the injection line to be shutdown.

7.4.8 Slowly **throttle CLOSE** HV-110S/HV-110D approximately one-turn every 5 to 15 minutes, while monitoring and maintaining steam boiler operation.

7.4.9 Monitor all steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D to verify steam injection piping depressurizing and draining at all locations.

7.4.10 After HV-110S/HV-110D fully closed, **slowly throttle OPEN** free-blow and drain valves approximately one-half to one-turn every 15 to 30 minutes in the injection line to be shutdown, while observing dry steam discharge from the free blow and drain valves.

7.4.11 Continue depressurizing steam injection pipeline until steam pressure at 0 psig on PG-100, PG-110S, and PG-110D. Proceed to next step once this has been achieved.

7.4.12 Review Steam Injection Shut-Down Valve Alignment Checklist (Attachment 3) for injection line to be shutdown to identify and reposition components in other than normal positions.

7.4.13 In Operations Log, record:
7.4.13.1 Completion of steam injection pipeline shutdown (specify which valves were closed: HV-110S, HV-110D, CV-115S1, CV-115S2, CV-115D1, CV-115D2).
7.4.13.2 Steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.
7.4.13.3 Final position of steam injection well hoses.
7.4.13.4 Completion of Attachment 3, if applicable.

7.4.14 Inform the Project Manager and STR that the specified steam injection piping shutdown and depressurization has been completed.

7.5 **Steam Injection Re-Start –** This section is performed to re-start an out of service steam injection pipeline or well.

7.5.1 Perform Steam Injection Pre-Start Valve Alignment Checklist (Attachment 1) to identify and reposition valves to the desired pre-start position.

NOTE: Individual valves or components that cannot be aligned according to the requirements of this procedure as described in Attachment 1 ("Steam Injection Pre-Start Valve Alignment

Checklist") should be annotated as deviations by placing a (N) in the Yes/No column next to the component on the checklist.

7.5.2 Determine which steam injection pipeline and/or well will be placed in service.

7.5.3 Obtain permission from the Project Manager and STR to re-start the out of service (shallow or deep) steam injection pipeline or well.

NOTE: Allow sufficient time for proper warm-up and blow-down (condensate removal) of the steam distribution system. This is the most critical part of starting up any steam system and shall never be expedited for the sake of time constraints.

7.5.4 In Operations Log, record:
- 7.5.4.1 Commencement of steam injection pipeline warmup.
- 7.5.4.2 Steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.
- 7.5.4.3 Initial position of steam injection well hose.
- 7.5.4.4 Completion of Attachment 1.

7.5.5 If the steam injection piping is already in service for the out of service steam injection well, bypass the remaining steps and proceed to step 7.5.19.

7.5.6 Ensure all drip legs in the out of service steam injection pipeline are in STARTUP service:
- 7.5.6.1 **CLOSE** valves A and B to isolate the steam trap (to prevent debris from clogging the internal strainer).
- 7.5.6.2 **CLOSE** valve C.
- 7.5.6.3 **Throttle OPEN** free-blow valve D approximately two turns.

NOTE: All free-blow and drain valves were partially opened as instructed in the Steam Injection Pre-Start Valve Alignment Checklist (Attachment 1). As the steam distribution piping warms, the free-blows and drains will eventually discharge dry steam, at which time the steam traps can be placed into service and the free-blow and drain valves closed. Free-blows and drains closer to the steam boiler will warm first, and will need to be closed sooner than more distant free-blows and drains.

CAUTION: Cold/hot condensate and eventually wet/dry steam will discharge from the free-blow and drain valves. Ensure all personnel are aware that start-up is in progress and areas around free-blows and drains are properly secured to prevent unauthorized access.

7.5.7 **Slowly** throttle **OPEN** steam well isolation bypass valve CV-115S1 (shallow injection) or CV-115D2 (deep injection) approximately one-turn, while monitoring and maintaining steam boiler operation, to allow condensate to drain into the well.

7.5.8 T**hrottle OPEN HV-110S/HV-110D** approximately one-half to one-turn to commence steam flow into the out of service steam injection pipeline.

7.5.9 Monitor thermal expansion pipe growth and **STOP** warmup if excessive growth occurs where pipeline becomes restricted or exceeds flexible hose lateral limit (3 inch).

7.5.10 Monitor steam and/or condensate discharging from all open free-blow and drain valves.

NOTE: Continuously monitor for indications of water hammer.

7.5.11 As the steam injection pipeline warms, continue to **throttle OPEN** free-blow and drain valves in one-half to one-turn increments, as needed, to discharge hot condensate and/or wet steam.

7.5.12 Monitor steam pressure build-up on PG-110S/PG-110D, PG-115S/PG-115D, and ET-100S/ET-100D.

CAUTION: Do not continue to open HV-110S/HV-110D if pressure regulators in the out of service steam injection pipeline (PRV-110S/PRV-110D) cannot control steam pressure at setpoint. Investigate reason regulator is not functioning before proceeding further.

7.5.13 Continue to **slowly throttle OPEN HV-110S/HV-110D** approximately one-half to one-turn every 15 to 30 minutes, while observing water/wet steam discharge from the free blow and drain valves.

7.5.14 When steam pressure in the out of service steam injection pipeline on PG-110S/PG-110D reaches the PRV-110S/PRV-110D setpoint, verify PRV-110S/PRV-110D regulating downstream pressure at setpoint.

7.5.15 Continue to **slowly THROTTLE OPEN HV-110S/HV-110D** approximately one-half to one-turn every 15 to 30 minutes, while observing water/wet steam discharge from the free blow and drain valves.

7.5.16 When HV-110S/HV-110D is FULLY OPEN, record steam parameters on PG-100, PG-110S, PG-110D, ET-100S, and ET-100D.

7.5.17 When only dry steam is discharging from the free-blow valves, place steam traps in service:

7.5.17.1 **Throttle CLOSE** valve D to approximately one-half turn open.

7.5.17.2 **OPEN** valves A and B.

7.2.17.3 Verify the steam trap is working properly, as evidenced by occasional bursts of hot condensate.

7.2.17.4 **Fully CLOSE** valve D.

7.5.18 **CLOSE** all steam trap free-blow D and drain valves.

7.5.19 Continue to **throttle OPEN** steam injection bypass valves CV-115S1/CV-115D1 approximately one-half to one-turn every 15 to 30 minutes until fully Open.

7.5.20 When CV-115S1/CV-115D1 fully open, **throttle OPEN** CV-115S2/CV-115D2 one-quarter turn to maintain steam injection pipeline in service.

7.5.21 In Operations Log, record:

7.5.21.1 Completion of steam distribution pipeline warmup.

7.5.21.2 Steam parameters on PG-100, PG-110S, PG-110D, PG-115S, PG-115D, ET-100S, and ET-100D.

7.5.21.3 Final expansion position of steam injection well hoses.

7.5.22 Inform the Project Manager and STR that the shallow/deep steam injection piping has been re-started.

7.5.23 Obtain Project Manager and STR permission to inject steam into the shallow and deep steam injection wells at the approved rates and schedule.

Attachment 1
Steam Injection Pre-Start Valve Alignment Checklist

Valve Number	Description	Required Position	Yes/No	Initials
HV-100	steam boiler supply isolation	closed		
HV-105	steam supply isolation	closed		
CV-106	steam supply isolation bypass	closed		
HV-110S	shallow steam injection isolation	open		
HV-110D	deep steam injection isolation	open		
HV-111S	shallow steam injection isolation	open		
HV-111D	isolation between rigid pipe and hose to -001	open		
PRV-110S	shallow pressure regulator valve	open		
PRV-110D	deep pressure regulator valve	open		
CV-110S	shallow PRV-110D bypass	closed		
CV-110D	deep PRV-110D bypass	closed		
HV-115S	shallow steam injection isolation	open		
HV-115D	isolation between rigid pipe and hose to -005	open		
CV-115S1	shallow steam injection flow control bypass	closed		
HV-115S2	shallow steam injection flow control	closed		
HV-115D1	deep steam injection flow control bypass	closed		
HV-115D2	deep steam injection flow control	closed		
MS-100D	moisture separator drain	open 1 turn		
-	PRV 110S inlet strainer drain	open 1 turn		
-	PRV 110D inlet strainer drain	open 1 turn		
A	steam trap isolation	closed		
B	steam trap isolation	closed		
C	steam trap vent isolation	closed		
D	drip leg drain	open 1 turn		
PG-100	steam supply pressure gauge isolation	open		
PG-110S	shallow regulated steam pressure gauge isolation	open		
PG-115S	shallow steam pressure gauge isolation	open		
PG-110D	deep regulated steam pressure gauge isolation	open		
PG-115D	deep steam pressure gauge isolation	open		

Notes:
HV = Hand Valve
CV = Control Valve
PRV = Pressure Regulating Valve

Attachment 2
Steam Injection Normal Valve Alignment Checklist

Valve Number	Description	Required Position	Yes/No	Initials
HV-100	steam boiler supply isolation	open		
HV-105	steam supply isolation	open		
CV-106	steam supply isolation bypass	closed		
HV-110S	shallow steam injection isolation	open		
HV-110D	deep steam injection isolation	open		
HV-111S	shallow steam injection isolation	open		
HV-111D	isolation between rigid pipe and hose to -001	open		
PRV-110S	shallow pressure regulator valve	open		
PRV-110D	deep pressure regulator valve	open		
CV-110S	shallow PRV-110D bypass	closed		
CV-110D	deep PRV-110D bypass	closed		
HV-115S	shallow steam injection isolation	open		
HV-115D	isolation between rigid pipe and hose to -005	open		
CV-115S1	shallow steam injection flow control bypass	closed		
HV-115S2	shallow steam injection flow control	closed		
HV-115D1	deep steam injection flow control bypass	open		
HV-115D2	deep steam injection flow control	open		
MS-100D	moisture separator drain	closed		
-	PRV 110S inlet strainer drain	closed		
-	PRV 110D inlet strainer drain	closed		
A	steam trap isolation	open		
B	steam trap isolation	open		
C	steam trap vent isolation	closed		
D	drip leg drain	closed		
PG-100	steam supply pressure gauge isolation	open		
PG-110S	shallow regulated steam pressure gauge isolation	open		
PG-115S	shallow steam pressure gauge isolation	open		
PG-110D	deep regulated steam pressure gauge isolation	open		
PG-115D	deep steam pressure gauge isolation	open		

Notes:

HV = Hand Valve

CV = Control Valve

PRV = Pressure Regulating Valve

Attachment 3
SRS Steam Injection Shutdown Valve Alignment Checklist

Valve Number	Description	Required Position	Yes/No	Initials
HV-100	steam boiler supply isolation	closed		
HV-105	steam supply isolation	closed		
CV-106	steam supply isolation bypass	closed		
HV-110S	shallow steam injection isolation	open		
HV-110D	deep steam injection isolation	open		
HV-111S	shallow steam injection isolation	open		
HV-111D	isolation between rigid pipe and hose to -001	open		
PRV-110S	shallow pressure regulator valve	open		
PRV-110D	deep pressure regulator valve	open		
CV-110S	shallow PRV-110D bypass	closed		
CV-110D	deep PRV-110D bypass	closed		
HV-115S	shallow steam injection isolation	closed		
HV-115D	isolation between rigid pipe and hose to -005	closed		
CV-115S1	shallow steam injection flow control bypass	closed		
HV-115S2	shallow steam injection flow control	closed		
HV-115D1	deep steam injection flow control bypass	closed		
HV-115D2	deep steam injection flow control	closed		
MS-100D	moisture separator drain	closed		
-	PRV 110S inlet strainer drain	closed		
-	PRV 110D inlet strainer drain	closed		
A	steam trap isolation	open		
B	steam trap isolation	open		
C	steam trap vent isolation	closed		
D	drip leg drain	partially open		
PG-100	steam supply pressure gauge isolation	open		
PG-110S	shallow regulated steam pressure gauge isolation	open		
PG-115S	shallow steam pressure gauge isolation	open		
PG-110D	deep regulated steam pressure gauge isolation	open		
PG-115D	deep steam pressure gauge isolation	open		

Notes:
HV = Hand Valve
CV = Control Valve
PRV = Pressure Regulating Valve

MANDATORY CONTRACTOR PROCEDURE		IMPLEMENTATION CROSSWALK		
Number - Rev.	Title	Contractor Designation	Subcontractor Designation	Other Implementation Clarification
PAD-SH-1002	Working on or Near Energized Electrical Equipment	PAD-SH-1002	PAD-SH-1002	None Required
PAD-SH-0014	Worker Fatigue Policy	PAD-SH-0014	PAD-SH-0014	None Required
PAD-SH-1015	Scaffolds and Portable Ladders	PAD-SH-1015	PAD-SH-1015	None Required
PAD-IH-5110	Biological Monitoring for Industrial Chemicals	PAD-IH-5110	PAD-IH-5110	None Required
PAD-IH-5113	Requesting and Providing IH Exposure History Records	PAD-IH-5113	PAD-IH-5113	None Required
PAD-IH-5121	Occupational Noise Exposure and Hearing Conservation	PAD-IH-5121	PAD-IH-5121	None Required
PAD-IH-5134	Temperature Extremes	PAD-IH-5134	PAD-IH-5134	None Required
PAD-IH-5135	Bloodborne Pathogens and First Aid	PAD-IH-5135	PAD-IH-5135	None Required
PAD-IH-5138	Confined Space Program	PAD-IH-5138	PAD-IH-5138	None Required
PAD-IH-5140	Hazard Communication	PAD-IH-5140	PAD-IH-5140	None Required
PAD-IH-5151	Issue, Control and Use of Respiratory Protection Equipment	PAD-IH-5151	PAD-IH-5151	None Required
PAD-IH-5181	Hazardous Material Information and Inventory Process	PAD-IH-5181	PAD-IH-5181	None Required
PAD-IH-5558	Industrial Hygiene Measuring & Testing Equipment Calibration	PAD-IH-5558	PAD-IH-5558	None Required
PAD-IH-5560	Workplace Industrial Hygiene Sampling	PAD-IH-5560	PAD-IH-5560	None Required
PAD-PLA-HS-001	LATA Environmental Services of Kentucky, LLC Worker Safety and Health Plan Paducah Remediation Services Project	PAD-PLA-HS-001	PAD-PLA-HS-001	None Required
PAD-PLA-HS-002	LATA Environmental Services of Kentucky, LLC Radiation Protection Program at the Paducah Gaseous Diffusion Plant,	PAD-PLA-HS-002	PAD-PLA-HS-002	None Required
PAD-PLA-PM-008	LATA Environmental Services of Kentucky, LLC Site Emergency Plan for the Paducah Remediation Project	PAD-PLA-PM-008	PAD-PLA-PM-008	None Required
PAD-PLA-SAF-001	Integrated Safety Management System Description and Environmental Management System Description for the Paducah Environmental Remediation Project, Paducah, Kentucky	PAD-PLA-SAF-001	PAD-PLA-SAF-001	None Required
PAD-PROG-0020	Electrical Safety Program Paducah Environmental Remediation Project, Paducah, Kentucky	PAD-PROG-0020	PAD-PROG-0020	None Required
PAD-PROG-0028	Respiratory Protection Program for LATA Environmental Services of Kentucky, LLC	PAD-PROG-0028	PAD-PROG-0028	None Required
PAD-PROG-0034	Chemical Safety Management Program for LATA Environmental Services of Kentucky, LLC	PAD-PROG-0034	PAD-PROG-0034	None Required
PAD-REG-1006	Best Management Practices Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky	PAD-REG-1006	PAD-REG-1006	None Required
PAD-SH-1006	Personal Protective Equipment	PAD-SH-1006	PAD-SH-1006	None Required
PAD-SH-1007	Initial Incident/Event Reporting	PAD-SH-1007	PAD-SH-1007	None Required
PAD-SH-2000	General Safety Requirements	PAD-SH-2000	PAD-SH-2000	None Required
PAD-SH-2001	Identifying Defective Equipment	PAD-SH-2001	PAD-SH-2001	None Required
PAD-SH-2003	Industrial Equipment Operations Qualification Program	PAD-SH-2003	PAD-SH-2003	None Required
PAD-SH-2004	Fall Prevention and Protection	PAD-SH-2004	PAD-SH-2004	None Required
PAD-SH-2005	Battery Charging Areas	PAD-SH-2005	PAD-SH-2005	None Required
PAD-SH-2007	Powered Industrial Trucks	PAD-SH-2007	PAD-SH-2007	None Required
PAD-SH-2008	Articulating boom Work Platform Operation	PAD-SH-2008	PAD-SH-2008	None Required
PAD-SH-2010	Hazard Assessment	PAD-SH-2010	PAD-SH-2010	None Required
PAD-SH-2017	Emergency Showers and Eyewash Equipment	PAD-SH-2017	PAD-SH-2017	None Required
PAD-SH-2018	Stop/Suspend Work (Safety Related)	PAD-SH-2018	PAD-SH-2018	None Required
PAD-SH-2020	Hotwork	PAD-SH-2020	Need from Murtco	None Required
PAD-SH-8003	Occupational Medicine	PAD-SH-8003	PAD-SH-8003	None Required
PAD-WC-0018	Work Planning and Control Program for the Paducah Environmental Remediation Project	PAD-WC-0018	PAD-WC-0018	None Required
PAD-WC-0020	Work Control Planning	PAD-WC-0020	PAD-WC-0020	None Required
PAD-WC-0021	Work Release and Field Execution	PAD-WC-0021	PAD-WC-0021	None Required
PAD-WC-0022	Work Control Closeout	PAD-WC-0022	PAD-WC-0022	None Required
PAD-WC-0044	Adherence to Performance Documents	PAD-WC-0044	PAD-WC-0044	None Required
PAD-ENM-0069	Monitoring Well and Associated Infrastructure Installation	PAD-ENM-0069	PAD-ENM-0069	None Required
PAD-ENM-2300	Collection of Soil Samples	PAD-ENM-2300	N/A	None Required
PAD-ENM-2303	Borehole Logging	PAD-ENM-2303	N/A	None Required
PAD-ENM-2700	Logbooks and Data Forms	PAD-ENM-2700	PAD-ENM-2700	None Required
PAD-ENM-2702	Decontamination of Sampling Equipment and Devices	PAD-ENM-2702	PAD-ENM-2702	None Required
PAD-ENM-2708	Chain-of-Custody forms, Fields Sample Logs, Sample Labels, and Custody Seals	PAD-ENM-2708	N/A	None Required
PAD-ENM-5003	Quality Assured Data	PAD-ENM-5003	N/A	None Required
PAD-ENM-5004	Sample Tracking, Lab Coordination, and Sample Handling	PAD-ENM-5004	N/A	None Required
PAD-DD-2701	Large Equipment Decontamination	PAD-DD-2701	PAD-DD-2701	None Required
PAD-HR-1000	Employee Concerns Program	PAD-HR-1000	PAD-HR-1000	None Required
PAD-WD-0011	Waste Acceptance Criteria for the Treatment, Storage, and Disposal Facilities at the Paducah DOE Site	PAD-WD-0011	N/A	None Required
PAD-WD-0019	On-site Transfer and Movement of Waste Containers and Other Support Equipment	PAD-WD-0019	N/A	None Required
PAD-WD-0022	Waste Water Accumulation, Storage, Treatment, and Disposal	PAD-WD-0022	N/A	None Required
PAD-WD-0661	Transportation Safety Document for On-Site Transportation within the PGDP	PAD-WD-0661	N/A	None Required
PAD-WD-1017	Safe Handling and Opening of Sealed Containers	PAD-WD-1017	N/A	None Required
PAD-WD-3010	Waste Generator Responsibilities for Temporary On-Site Storage of Waste Materials at Paducah	PAD-WD-3010	N/A	None Required
PAD-PLA-QM-001	Quality Assurance Program and Implementation Plan for the Paducah Environmental Remediation Project	PAD-PLA-QM-001	PAD-PLA-QM-001	None Required
PAD-QA-0006	QA Requirements Receipt Inspection and Handling and Storage of Material Items	PAD-QA-0006	PAD-QA-0006	None Required
PAD-QA-1009	Identification, Control, and Disposition of Suspect/Counterfeit Items	PAD-QA-1009	PAD-QA-1009	None Required
PAD-QA-1020	Control and Calibration of Measuring and Test Equipment	PAD-QA-1020	PAD-QA-1020	None Required
PAD-QA-1208	Approved Supplier Selection and Evaluation	PAD-QA-1208	PAD-QA-1208	None Required
PAD-QA-1240	Operating Experience/Lessons Learned	PAD-QA-1240	PAD-QA-1240	None Required
PAD-QA-1420	Conduct of Management Assessments	PAD-QA-1420	PAD-QA-1420	None Required

PAD-QA-1440	Processes	PAD-QA-1440	PAD-QA-1440	None Required
PAD-QA-1520	Readiness Reviews for Radiological, Non-Nuclear, and Other Industrial Facilities/Activities	PAD-QA-1520	PAD-QA-1520	None Required
PAD-QA-1650	Graded Approach	PAD-QA-1650	PAD-QA-1650	None Required
PAD-ENG-0001	Field Engineering Inspections and Surveys	PAD-ENG-0001	PAD-ENG-0001	None Required
PAD-ENG-0012	Hoisting and Rigging Operations	PAD-ENG-0012	PAD-ENG-0012	None Required
PAD-ENG-0026	Excavation/Penetration Permit	PAD-ENG-0026	ERM Subsurface Clearance Policy Version 3.0	None Required
PAD-ENG-0027	Field Change Request, Field Change Notice, and Design Change Notice Process	PAD-ENG-0027	PAD-ENG-0027	None Required
PAD-ENG-0042	Pressure Safety	PAD-ENG-0042	PAD-ENG-0042	None Required
PAD-ENG-0051	Controlling Combustibles and Ignition Sources	PAD-ENG-0051	PAD-ENG-0051	None Required
PAD-ENG-0053	Fire Extinguisher Inspection and Maintenance	PAD-ENG-0053	PAD-ENG-0053	None Required
PAD-PROG-0030	Fire Protection Program Description for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky	PAD-PROG-0030	PAD-PROG-0030	None Required
PAD-PLA-ENV-001	Management Plan for the Paducah Environmental Remediation Project	PAD-PLA-ENV-001	PAD-PLA-ENV-001	None Required
PAD-PROG-0014	Environmental Compliance & Protection Program Description for LATA Environmental Services of Kentucky, LLC	PAD-PROG-0014	PAD-PROG-0014	None Required
PAD-PROG-0015	Pollution Prevention/Waste Minimization Program for the U.S. DOE Paducah Remediation Project	PAD-PROG-0015	PAD-PROG-0015	None Required
PAD-PROG-0016	Project Training Program Description for the Paducah Environmental Remediation Project, Paducah, Kentucky	PAD-PROG-0016	PAD-PROG-0016	None Required
PAD-PD-1107	Development, Approval, and Change Control for LATA Kentucky Performance Documents	PAD-PD-1107	PAD-PD-1107	None Required
PAD-PRO-QM-002	Operations Applicability Matrix for the Paducah Environmental Remediation Project	PAD-PRO-QM-002	PAD-PRO-QM-002	None Required
PAD-RM-1009	Records Management, Administrative Record, and Document Control	PAD-RM-1009	PAD-RM-1009	None Required
PAD-RAD-0303	Unrestricted Radiological Release of Excess Property, Equipment, and Materials at the PGDP	PAD-RAD-0303	PAD-RAD-0303	None Required
PAD-RAD-0305	Company Issued Clothing	PAD-RAD-0305	PAD-RAD-0305	None Required
PAD-RAD-1101	Radiation Exposure Limits	PAD-RAD-1101	PAD-RAD-1101	None Required
PAD-RAD-1103	Personnel and Personal Effects Decontamination	PAD-RAD-1103	PAD-RAD-1103	None Required
PAD-RAD-1104	Radiological Area Entry Control	PAD-RAD-1104	PAD-RAD-1104	None Required
PAD-RAD-1105	Receipt, Transport, and Movement of Radioactive Materials	PAD-RAD-1105	PAD-RAD-1105	None Required
PAD-RAD-1106	Selection and Use of Anti-Contamination Clothing	PAD-RAD-1106	PAD-RAD-1106	None Required
PAD-RAD-1107	Workplace Air Monitoring for Radioactivity	PAD-RAD-1107	PAD-RAD-1107	None Required
PAD-RAD-1108	Posting and Labeling	PAD-RAD-1108	PAD-RAD-1108	None Required
PAD-RAD-1109	Radioactive Contamination Control and Monitoring	PAD-RAD-1109	PAD-RAD-1109	None Required
PAD-RAD-1110	Radiation Surveys	PAD-RAD-1110	PAD-RAD-1110	None Required
PAD-RAD-1111	Workplace Monitoring	PAD-RAD-1111	PAD-RAD-1111	None Required
PAD-RAD-1112	Air Sampling Collection, Analysis, and Documentation	PAD-RAD-1112	PAD-RAD-1112	None Required
PAD-RAD-1114	ALARA Program	PAD-RAD-1114	PAD-RAD-1114	None Required
PAD-RAD-1116	Vehicle Radiological Control	PAD-RAD-1116	PAD-RAD-1116	None Required
PAD-RAD-1117	Accidents and Emergencies	PAD-RAD-1117	PAD-RAD-1117	None Required
PAD-RAD-1201	Internal Dosimetry	PAD-RAD-1201	PAD-RAD-1201	None Required
PAD-RAD-1202	External Dosimetry	PAD-RAD-1202	PAD-RAD-1202	None Required
PAD-RAD-1203	Embryo/Fetus Protection	PAD-RAD-1203	PAD-RAD-1203	None Required
PAD-RAD-1208	Work Notification of Bioassay Result	PAD-RAD-1208	PAD-RAD-1208	None Required
PAD-RAD-1209	In Processing Individuals to be Monitored by Dosimetry	PAD-RAD-1209	PAD-RAD-1209	None Required
PAD-RAD-1213	Bioassay Sample Submittal and Check-in	PAD-RAD-1213	PAD-RAD-1213	None Required
PAD-RAD-1216	Management of Non-Routine Bioassay Samples	PAD-RAD-1216	PAD-RAD-1216	None Required
PAD-RAD-1301	Radiation Generating Devices	PAD-RAD-1301	PAD-RAD-1301	None Required
PAD-RAD-1302	Radioactive Source Control	PAD-RAD-1302	PAD-RAD-1302	None Required
PAD-RAD-1505	Radiological Notification Reporting	PAD-RAD-1505	PAD-RAD-1505	None Required
PAD-RAD-1601	Radiation Safety Training	PAD-RAD-1601	PAD-RAD-1601	None Required
PAD-RAD-1603	Radiological Site Access Requirements & Site Access Cards	PAD-RAD-1603	PAD-RAD-1603	None Required
PAD-REG-0003	Performing Environmental Compliance Assessments and Identification and Reporting of Environmental Issues	PAD-REG-0003	PAD-REG-0003	None Required
PAD-SM-0006	Construction Equipment Inspection and Maintenance	PAD-SM-0006	PAD-SM-0006	None Required
PAD-NS-1008	Unreviewed Change Determinations for Radiological and Non-Nuclear Facilities	PAD-NS-1008	PAD-NS-1008	None Required
PAD-NS-1009	Safety Documentation for Radiological and Non-Nuclear Facilities	PAD-NS-1009	PAD-NS-1009	None Required
PAD-PROG-0037	Nuclear Safety Program Description for the Paducah Environmental Remediation Project	PAD-PROG-0037	PAD-PROG-0037	None Required