Removal C-Site MG Sets & OTHER EQUIPMENTS

Statement of Work

Revision 4

Prepared by: _____ Date: 10/22/10
Mounir Awad

Reviewed by: _____ Date: 10/25/2010
John Lacenere

Reviewed by: _____ Date: 10/26/10
PPPL Construction Engineering: Erik Perry

Reviewed by: _____ Date: 10/25/2010
Quality Assurance: Barry Jedic

Reviewed by: _____ Date: 10/25/10
Head, ES&H: Jerry Levine

Reviewed by: _____ Date: 10/25/10
Electrical Engineering / RLM: Al Von Halle

Reviewed by: _____ Date: 10/25/10
Head, Material & Environmental Service: R. Sheneman

Approved by: _____ Date: 25 Oct 2010
Head, Maintenance & Operation: Shawn Connolly

Table of Contents

1.0 Introduction 3
1.1 Overview 3
1.2 Milestones 6
1.3 Safety Training Requirements 6
1.4 Export Restriction Notice 6
2.0 Applicable Documents 7
3.0 Requirements and Responsibilities for this SOW 8
3.1 Overall Responsibilities 8
3.2 Technical and Administrative Responsibilities 9
3.3 Deliverables 10
3.4 Organization and Logistics 11
3.5 Other Requirements 12
4.0 Environment, Safety, and Health Requirements 13

Appendix I: C-SITE MG Building Floor Plan (1st Floor and basement).

Appendix II: List of MG sets / auxiliaries and other equipments with pictures.

Appendix III: MG Sets Technical Data

Appendix IV: Estimated weights for MG sets and other equipments

Appendix V: Manufacture Reference Manuals & Assembly drawings for handling the MG sets

Appendix VI: 10CFR851, Worker Safety & Health Program

Appendix VII: Integrated Safety Management Plan

Appendix VIII: PPPL Hoisting and Rigging Procedure, ENG-021

Appendix IX: Lifting Devices Standards

Appendix X: Crane Inspection Form

1.0 Introduction

Princeton University Plasma Physics Laboratory's (PPPL's) DC energy storage motor-generator (MG) sets and auxiliaries are no longer capable of delivering the required power within the pulse duration for Fusion experiments in PPPL. This equipment described for removal herein has been abandoned in place and has not been maintained in decades. There is now a requirement to remove all MG sets and all their associated auxiliary equipment. This MG equipment is located within the C-Site MG building and part of Princeton University's James Forrestal Campus.

1.1 Overview

The proposed MG equipment (listed in Appendix I) removals are to prepare the building for an alternate usage. The technical objective of this effort is to have a subcontractor clear the MG bay area and the MG basement from the following:

- All MG sets / flywheels and associated switchgear (including high speed and resistor breakers).
- All DC copper bus runs from each generator terminals to the bus tunnels located in the east and west and bay areas and all transductors on each generator output.
- Duplex Board, control panels 6 to 17, to remove all marked components such as meters, relays, recording instruments, annunciator and associated control wiring.
- Two DC control boards consisting of (31) panels containing (14) DC field contactors, potentiometers & resistors, magnetic amplifiers, relays, meters, and wiring.
- Two reduced voltage starters for two 1750 HP chillers, rated voltage 4160.
- One frequency converter consisting of a 200 VDC power supply, 2 Amps, A 15 HP Synchronous motor, and a 365 KVA 480 cycles Synchronous generator.
- (36) Motorized DC Disconnect Switches manufactured by MEMCO.
- All associated oil pumps and jacking pumps.
- All associated oil tanks for each MG set and with their pipes, heat exchangers, and filters.
- All associated MG sets cooling Water piping and heat exchangers. Although all asbestos in the pipe insulation has been removed, always consider any area still might contain asbestos. PPPL HAZMAT group will be available for clarification and advice.
- DC / AC relays control boards and cables.
- Transfer control panels and cables
- Blowers and air filters.
- Small MG set (75 HP motor / 50 KW DC generator)
- Four generator exciter sets and two 400 c/s mg sets

- Dynamic brake MG set and associated switchgear
- Liquid Rheostats, control panel boards, heat exchangers
- Two Worthington chillers each with a 1750 HP wound-rotor slip-ring induction motor, an evaporator (18' long x 6' OD, and a condenser (16' long x 4' OD). Both evaporator and condenser may contain asbestos insulation. Both chillers have One Pump Down receiver (16' long x 4' OD). The method for removing these components will require a detail lift plan by the subcontractor due to the limiting space surrounding them. Two boxes of spare heat exchanger tubes.
- One 350 KW - Diesel Generator
- OH cooling water system which includes one (11' x 8') aluminum tank, a pump, a filter, a heat exchanger, and piping
- CARDOX Fire Extinguish systems include CO2 tank (4-ton storage capacity) / refrigerant compressor and associated piping, controls and alarms.
- HALON System. This subcontract includes proper disposal of a HALON 1301 fire suppression system. PPPL is required to ship excess HALON to the Department of Defense (DOD). The DOD will provide a 1000-pound water capacity tank for shipment.

- HALON system demolition work included under this subcontract:
    1. Transfer of approximately 425 pounds of HALON 1301 from the existing tank to a DOD furnished shipping container. In addition to the HALON, the tank also contains sufficient nitrogen to provide a 360-psi super pressure. An individual with proper training and with a State of New Jersey license must accomplish this work.
    2. Removal and disposal of tank and discharge piping after contents of tank have been removed.
- OH Dummy Load bus and related equipment
- Water Cooled bus enclosure, which include a filter coil and a bus. <u>PPPL will retain the filter coil and the bus</u> and will provide a procedure to carefully remove them from the concrete blocks. Six concrete blocks (24" x 48" x 48")
- S-1 machine Bus enclosure and contents.
- Two air conditioning units, Carrier, model # 50D024600. Each unit weighs 3,000. Lb. The refrigerant is drained and the oil will be drained after lifting them from the basement.

The total weight of all equipment to be removed is estimated to be over 5,000 tons. The calculated (estimated) weight of the copper is 150 tons.

Whereas the balance of the remaining materials weights are primarily a mixture of copper, steel, cast iron, Aluminum, and concrete.

PPPL will provide the manufacturer's drawings for assembly / disassembly, if they are available, to the subcontractor.
The subcontractor must inspect and certify all the lifting devices, see Appendix IX, prior to any lifting and provide all certifications to Princeton Technical Representative (PTR) for approval prior to any lifting activity.

Construction power is available in this area from existing 120V outlets and 480V receptacles.

Each flywheel size is approximately 18 feet in diameter and weights approximately 95.7 tons, which exceeds the overhead building crane lifting capacity rated at 75 tons. Each flywheel shall therefore be cut / de-assembled and reduced in size and weight such that it can be lifted by the overhead crane pass through the opening of the existing roll up door. The lay down area by the existing west roll up door is approximately 25' x 27'.

There are additional Shoring columns located at the west side by the roll-up door facing shaft #1 & 2 to support generator loading (about 40 tons) on low boy trailer based on the following:
The weight of the trailer is 26,000 lb
The weight of generator rotor is 90,000 lb
The weight of the skid is 4,000 lb
Total weight is 120,000 lb
Trailer dimension is 23' x 8'
No. of Axials 4
No. of tires per Axial 4
Cap has 8 tires, and two tires at the pivot point
Spacing between trailer axial starting from pivot points are:
4'6", 4'2", 5'7" and 4'2"
Subcontractor must use PPPL truck scale for all equipment to be removed. Max load is 120,000 lb

All activities must be done in a safe manner that does not jeopardize personnel, the building structure or in-service equipment / systems located within the C-Site MG building first floor and basement.
Prior to commencing any work, all lifting plan must be submitted to Princeton Technical Representative (PTR) who will get the approval from the PPPL Lift engineer. Any welding plan must be submitted to Princeton Technical Representative (PTR) who will get the approval from the PPPL Welding engineer.

1.2 Milestones

The major milestones for C-Site MG removal task are currently:

Commence equipment demolition and removal by February 21st, 2011

Complete all removals by September 30, 2011

1.3 Safety Training Requirements

Personnel who will be on-site more than 40 hours must pass a General Employee Training (GET) course that takes approximately 2 hours.

Personnel who will be performing Fire Watches duty must pass a one-hour PPPL Training course.

The C-Site MG pit has been classified as a Non-Permit Confined Space, meaning that unless new hazards are introduced (such as torch cutting) no permit or training is required. Access to the main floor areas of the C-MG enclosure requires fall protection and may be considered Permit-Required Confined Spaces until the fall hazard has been removed. Therefore confined space training is required.

1.4 Export Restriction Notice

The use, disposition, export and re-export of this property are subject to all applicable U.S. laws and regulations, including the Atomic Energy Act of 1954, as amended; the Arms Export Control Act (22 U.S.C. 2751 et seq.); the Export Administration Act of 1979(560 U.S.C. Append 2401 et seq.); Assistance to Foreign Atomic Energy Activities (10 CFR part 810); Export and Import of Nuclear Equipment and Material (10 CFR part 110); International Traffic In Arms Regulations (22 CFR parts 120 et seq.); Export Administration Regulations (15 CFR part 730 et seq.); Foreign Assets Control Regulations (31 CFR parts 500 et seq.); and the Espionage Act (37 USC 791 et seq.) which among other things prohibit:

a. The making of false statements and concealment of any material information regarding the use or disposition, export or re-export of the property; and

b. Any use or disposition, export or re-export of the property, which is not authorized in accordance with the provisions of this agreement.

2.0 Applicable Documents

NEPA Form # 1301 Rev. 1 (Excess C-Site MG sets)

DOE approval to excess the equipments:
(a) Memorandum, Faul to Prager, dated April 27, 2010
(b) Memorandum, Faul to Baldwin, dated March 4, 2010
(c) Memorandum, Siebach to Faul, dated March 29, 2010

Work Planning # 1626, 1631, 1577

10CFR851, Worker Safety & Health Program. (Appendix VI of this Statement of Work)

PPPL ES&H Manual
http://www.pppl.gov/eshis/ESHD_MANUAL/sm.html

PPPL Integrated Safety Management document (Appendix VII of this Statement of Work)

PPPL Hoisting and Rigging Procedure (Appendix VIII of this Statement of Work)

ALLIS-CHALMERS INSTRUCTION BOOK – CSA Purchase Order No. C-49

ALLIS-CHALMERS INSTRUCTION BOOK - for liquid rheostat type 257 size 3 & 6

ITE –DIRECT CURRENT SWITCH GEAR TYPE FB-60

ITE –DRAWOUT MOUNTED BREAKER TYPE KF with shunt resistor.

WORTHINGTON INSTRUCTION BOOK for two chillers includes 1750 HP - Squirrel Cage motor for compressor drive, evaporator and condenser.

CARDOX – Fire Extinguishing Equipment, Operation and Service Manual

Manufacturer's assembly drawings list for handling the MG sets (See Appendix V of this Statement of Work).

3.0 Requirements and Responsibilities for this SOW

3.1 Overall Responsibilities

3.1.1 Activities Prior to Field Work

- The major activities that will be performed by the Removal Subcontractor prior to the actual removal will be to:
- Develop and submit a lifting and removal plan for PPPL approval.
- Develop and submit an Integrated Safety Management Plan for PPPL approval.
- Develop and submit for PPPL approval detailed lift procedures for each piece of equipment.
- Provide proof of training and appropriate credentials for all proposed crane operators
- Mobilize the labor (including training) and materials / tools required
- Furnish for PPPL approval a control log form for a scrap control log that includes item description and its weight. This form shall be filled out prior to removal of materials from PPPL site.
- Provide a list of qualified New Jersey licensed subcontractors for asbestos and HALON system removals.

3.1.2 Field Work

The C-Site MG Removal Subcontractor will proceed with the physical fieldwork in accordance with PPPL approved CMG Removal Plan and PPPL approved lift procedures.

All weights listed for items to be removed are **ONLY ESTIMATED VALUES** and are not the actual weight. The determination of the actual weight and value will be the responsibility of the subcontractor

The subcontractor has the option to sell the equipments as used equipment or as a scrap material whichever yields higher revenue. All sales must comply with export control provisions.

The subcontractor will keep a Control Log of all the materials / equipments indicating the amount and the type of material removed from the site and the revenue generated from the sale of those materials.

3.1.3 Environment, Safety and Health Support

During CMG removal, the subcontractor will be responsible for the Environment, Safety, Health requirements, but that PPPL will provide technical advice where appropriate. Specific areas include Electrical Safety, Construction Safety, Industrial Hygiene, and Industrial Safety.

3.1.4 Scrap Metals

It will be the responsibility of the Subcontractor to remove from the site all scrap metals and all general construction waste. The subcontractor must record the weight of each item removed before leaving the site. The Subcontractor shall maintain, and deliver to PPPL on a weekly basis during the work, a Control Log for all scrap metals (copper, steel, aluminum, etc.) showing the weights and the scrap revenue. Weights must be documented using either PPPL's on-site truck scale (subject to weight and length restrictions) or with weight tickets from a certified truck scale. Copies of weight tickets must accompany log entries.

3.2 Technical and Administrative Responsibilities

The Subcontractor shall be responsible for all technical aspects of the CMG Removal, including work performed by their lower-tier Subcontractors. Responsibilities include, but are not limited to, those defined here:

3.2.1 Perform the work in such a way that meets the requirements of:

1) The functional requirements of section 3.1;

2) The ES&H requirements of section 4.0.

3.2.2 Plan, manage, and control the removal activities per established procedures.

3.2.3 Provide technical surveillance of all fieldwork.

3.3 Deliverables

General lift, removal, disposal, etc. plan is required to be submitted and approved by PPPL prior to the start of any onsite work. Subsequent lift, removal, disposal, etc. plans will be required for specific removal of equipment that may need more detailed planning. The subsequent plans will require PPPL review and approval before the particular lift, removal, disposal, etc. can take place.

The following items shall be furnished:

3.3.1 Detailed removal plan and lift procedures shall be prepared by the Subcontractor and approved by the PPPL Princeton Technical Representative (PTR) prior to the initiation of any field work, and in no event later than four weeks after the subcontract award.

3.3.2 Completion of removal no later than September 30, 2011

3.3.3 Prior to the start of the field work, the Subcontractor shall submit the following and obtain PPPL (PTR) approval:

3.3.4 Removal plan

3.3.5 Integrated Safety Management Plan (must be consistent with DOE Policy P450.4, "Safety Management System Policy" PPPL Integrated Safety Management document, Revision 11 – October 2009) and a specific Job Hazard Analysis. The plan must include the subcontractor's proposed detail methods for removing, transporting, and disposing of asbestos or asbestos-containing materials (ACM). Asbestos abatement activities must be performed by licensed contractors in compliance with all Federal and state asbestos regulations.

The plan should include a detail method of handling the HALON removal from the existing tank to containers that will be provided by Department of Defense (DOD) and transportation to their facility.

3.3.6 Crane usage plan / Lift Procedures

3.3.7 Certifications for Lift personnel and equipment. This should include forklift operator, crane operator, rigger, and mobile crane certification.

3.3.8 Qualifications for welders and weld procedures, if any welding is proposed.

3.3.9 Identification and copies of certifications for New Jersey certified subcontractors to remove, transport, and to handle the removal and shipping of the HALON system.

3.3.10 Proposed Scrap Control Log Form

3.3.11 List of hazardous chemicals that will be brought on site and applicable Material Safety Data Sheets (MSDS's)

3.3.12 Fall protection plan

3.3.13 On a weekly basis during the work, upon completion, of the removal, and at other intervals at PPPL's request, the Subcontractor shall submit the Scrap Control Log and accompanying weigh tickets for all material/equipment shipments associate with the project (See 3.1.4).

3.3.14 125% proof load test certificate for all lifting devices

3.3.15 MSDS for hazardous material brought on site.

3.3.16 Load Test Certificates of any below the hook lifting devices or lift beams

3.4 Organization and Logistics

3.4.1 Removal Manager

The Removal Manager shall be the Subcontractor's employee designated by the Subcontractor for performance of the functions outlined in this SOW. The individual so designated shall have supervisory experience in the disassembly and removal of equipment / machinery in the field. During the removal phase, the designated individual shall be physically present at the work site whenever the subcontractor's personnel are on-site and shall be engaged in the managing, directing, monitoring, and coordinating of work to assure completing the CMG removal within the schedule objectives.

3.4.2 Reporting

The Subcontractor shall report to the PPPL Princeton Technical Representative (PTR) or designee. The Princeton Technical Representative (PTR) shall serve as the single–point PPPL contact for technical issues and direction. Once field activities begin, a daily coordination meeting with the PPPL Princeton Technical Representative (PTR) will also be required to provide adequate interface between the Subcontractor's field crews and other activities that may impact or be impacted by the Subcontractor's activities.

3.4.3 Working Hours

All work on-site shall be performed between the hours of 7:00 AM and 5:00 PM, Monday through Friday, 8 hours/day, 5 days / week, unless special advance written permission is received from Princeton Technical Representative.

3.4.4 Housekeeping

The subcontractor is responsible for cleaning up the work area each day before leaving the site.

3.5 Other Requirements

3.5.1 Control of Special Processes

The Subcontractor shall use trained and qualified personnel and written procedures for the performance of certain special processes, including but not limited to, plasma arc cutting, welding, if any welding to be performed.

- The Subcontractor's welder(s) shall be qualified to the current edition of ASME B&PV Code Section IX or AWS D1.1.
- The Subcontractor's welding procedures shall be qualified to the current edition of ASME B&PV Code Section IX or AWS D1.1.

If welding is to be performed, the Subcontractor shall provide all qualifications of personnel performing the welding for PPPL review and approval. PPPL approval is required prior to the start of welding.

3.5.2 Changes to PPPL-Approved Documents

Revisions or changes by the Subcontractor to documents previously approved by PPPL (PTR) shall be reviewed and approved by the Princeton Technical Representative (PTR) prior to use by the Subcontractor.

4.0 Environment, Safety, and Health Requirements

PPPL has an institutional commitment to Environment, Safety, and Health (ES&H). All onsite work performed under this Subcontract should be in accordance with PPPL General Provisions for Non-Commercial Items and Services listed in Clause T2 entitled "Compliance with 10 CFR 851 and Princeton worker safety and health program by integration of Environment, Safety and health into work Planning and Execution".

The Subcontractor must prepare a written Integrated Safety Management (ISM) Plan (construction project safety and health plan) that implements the requirements below for the construction work under their responsibility and obtain approval of the plan by Princeton Technical Representative (PTR) prior to commencement of any work covered by the plan. In the plan, the contractor must designate the individual(s) responsible for its on-site implementation, specify qualifications for those individuals, and provide a list of those project activities for which subsequent job hazard analyses are to be performed. The level of detail within the ISM Plan should be commensurate with the size, complexity and risk level of the construction project. In addition the contractor shall:

1. Prepare and have approved by the Princeton Technical Representative (PTR) a job hazard analyses (JHAs) in accordance with PPPL procedure ESH-004 prior to commencement of affected work. The JHAs must identity foreseeable hazards and protective measures, and address further hazards revealed by any supplemental information provided by the PTR.
2. Provide for approval drawings and/or other documentation of protective measures for which applicable OSHA standards require preparation by a Professional Engineer or other qualified individual (these should be included in the ISM Plan).
3. Identify for approval by the PPPL Construction Manager competent persons for activities as required by applicable OSHA standards (these should be included in the ISM Plan).
4. Ensure workers are aware of foreseeable hazards and the protective measures as defined by the JHAs, and require that workers acknowledge being so informed.
5. Ensure that workers not following the safe work practices are subject to the Subcontractor's disciplinary process.

6. Maintain a designated representative onsite during all active construction that is knowledgeable of the associated hazards and has the authority to act on behalf of the Subcontractor and that makes frequent and regular inspections of the construction worksite to identify and correct any instances of noncompliance with project safety and health requirements.
7. Instruct workers to report to the Subcontractor's designated representative, hazards not previously identified or evaluated. If immediate corrective action is not possible or the hazard falls outside the project scope, the Subcontractor must immediately notify affected workers, post appropriate warning signs, modify the appropriate JHAs, implement needed interim control measures, and notify the PTR of the action taken. The Subcontractor or the designated representative must stop work in the affected area until appropriate protective measures are established.

All lifts shall conform to the PPPL Hoisting and Rigging Procedure, #ENG-021.

All work performed under this Scope of Work must conform to the requirements of 10CFR851, Worker Safety & Health Program, (Appendix VI of this Statement of Work).

All work performed under this Scope of Work must conform to OSHA requirements.

All personnel have the right and responsibility to stop unsafe work (GP clause T5).

The insulation of the cooling water piping and the chillers evaporators may contain asbestos. PPPL removed all the visible insulation that contains asbestos. The subcontractor must be very careful of any suspected asbestos material and stop immediately and inform the PTR for corrective action. Any asbestos removal must be done through a licensed asbestos abatement contractor to remove and dispose of all asbestos material prior equipment/scrap removal activities. The subcontractor must possess and submits all proper licensing, especially for the removal, disposal, and transportation of asbestos.

All equipment shall have all safety-related features in place and working properly. Equipment must be operated in a safe manner at all times.

Equipment brought on site must not have leaks (fuel, oil, hydraulic fluid, etc.). General Provision clause T7 ("Contaminant Spills") must be complied with if any leaks occur.

The subcontractor is responsible for its equipment at all times while the equipment is on PPPL's site. This includes but is not limited to oil leaks, fuel leaks and operator damage.

PPPL may cleanup any spills caused by subcontractor negligence, utilizing resources other than those supplied by the subcontractor. The subcontractor will be responsible for the cost of any cleanup service performed by PPPL.

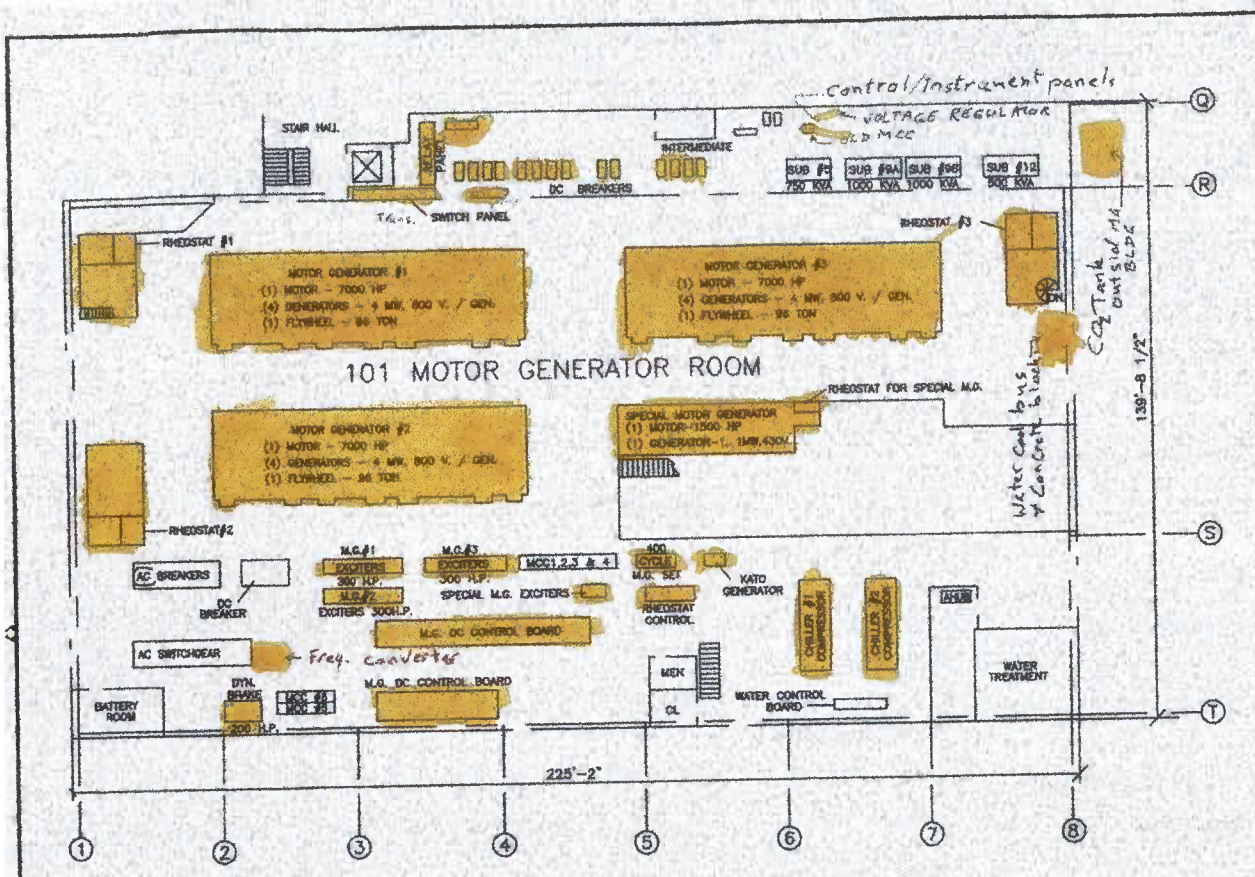
Material Safety Data Sheets (MSDS) for all chemicals must be provided to PPPL Industrial Hygiene Group at least 24 hours before being brought on site.

APPENDIX I

C – MG BUILDING 1st FLOOR PLAN

The equipments to be removed are highlighted in yellow in the 1st floor plan of the C-Site MG building.

NO.	DATE	REVISION	BY	CH	APPROVI	
1	6/03	REVISED PER ECN-4772	JJN	S.F.	CAP	J.S.
2	3/24/08	REVISED SQUARE FOOTAGE PER ECN-5342	JJN			



BLDG. C51

	GSF	NSF
C-SITE M.G. 1st FL.	30,566	30,200

PRINCETON PLASMA PHYSICS LABORATOR

C & D SITES

BUILDING FLOOR PLANS

M.G. BUILDING
FIRST FLOOR

DIV. P.M.& E.	LOCAL CAD NO.			DATE: 10/6/02
ENG. C. POTENSKY	2BAD3026.DWG			B-AD30
DR. J. SIEGEL	APPROVALS			
CH. S. FLOHR	CP	SF	JS	SHEET NO. 2

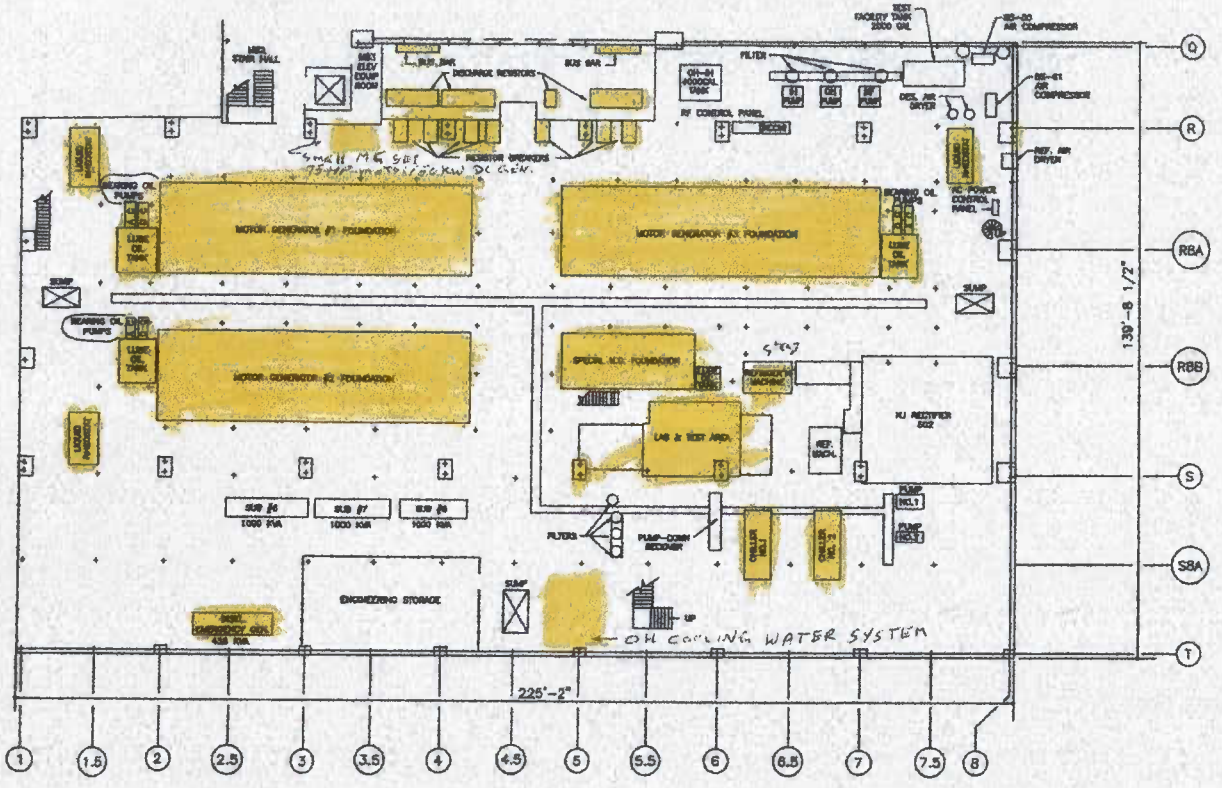
CMG-REMOVAL-SOW-030-R4

APPENDIX I

C – MG BUILDING BASEMENT

The equipments to be removed are highlighted in yellow in the basement floor plan of the C-Site MG building.

NO.	DATE	REVISION	BY	CH	APPROVE	
1	6/03	REVISED PER ECN-4772	JJN	S.F.	CAP	J.S.
2	3/24/08	REVISED SQUARE FOOTAGE PER ECN-5342	JJN			



BLDG. C51

	GSF	NSF
C-SITE M.G. BSMT.	30,566	30,200

PRINCETON PLASMA PHYSICS LABORATORY
C & D SITES
BUILDING FLOOR PLANS

M.G. BUILDING BASEMENT

DIV. P.M.& E.	LOCAL CAD NO.			DATE: 10/5/02
ENG. C. POTENSKY	2BAD3025.DWG			B- AD300
DR. J. SIEGEL	APPROVALS			
CH. S. FLOHR	CP	SF	JS	SHEET NO. 25

CMG-REMOVAL-SOW-030-R4

APPENDIX II

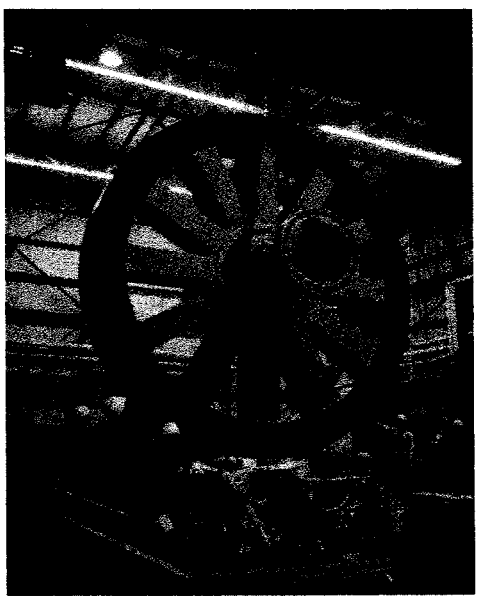
LIST OF MG SETS / AUXILIARIES AND OTHER EQUIPMENTS WITH PICTURES

1. Three (3) Large Pulse Motor Generators storage energy sets and a smaller MG set.
2. Associated switchgear:
3. Sixteen (16) ITE SWGR- model FB 60 – High speed breakers
4. Sixteen (16) ITE SWGR- model KF / A
5. Sixteen (16) Discharging Resistor load, .02 Ω, 30,000 A, 3 sec.
6. DC Copper buses
7. Duplex Panel Boards, panel # 6 to #17, front and rear, containing meters, relays, recording instruments, annunciators, and all associated control wires / cables.
8. Two DC Panel Boards, total of 31 panels, front and rear, containing 14 DC Field contactors, potentiometers, stick resistors, magnetic amplifiers, relays, and meters
9. One frequency converter consisting of a 200 VDC power supply, 2 Amps, a 15 HP synchronous motor, and a 365 KVA 480 cycles Synchronous generator.
10. (36) Motorized DC Disconnect Switches, MEMCO, 1200 VDC, 5500 A
11. Eight (8) AC / DC Bearing oil pumps & six (6) jacking pumps
12. Three (3) large bearing oil tanks and one (small) tank
13. Thirty four (34) heat exchangers and cooling water pipes
14. One (1) AC Relay boards, six (6) panels & two (2) DC Relay Boards, ten (10) panels. All contains relays and control wires / cables.
15. Twelve (12) Transfer Control Panels contain grove switches and cables.
16. Generators and motors air blowers and air filters consist of one motor drives two blower. Total of 32 blowers and 16 motors, 20 HP each, 1200 rpm.
17. Three (3) Motor Generator Exciter Sets and one (1) small set.
18. Two (2) Motor Generator Sets 400 cycles.
19. One (1) Dynamic Brake Motor Generator Set and associated switchgears.
20. Three (3) large Liquid Rheostat and one (1) small and four (4) control panel boards.
21. CARDOX Fire Extinguisher System consists of CO_2 tank (4 ton storage capacity), refrigerant compressor and associated piping, controls, and alarms.
22. Voltage regulator

23. Imperial MG set consists of 75 HP motor and 50 KW DC Generator.
24. Two (2) Worthington Chillers including reduced starting voltage, two (2) wound-rotor slip-ring induction motors (1750 HP each), two (2) Evaporators (16' long, 4' OD, 46.5" ID, and two (2) condensers 12' long, 5' diameter.
25. 350 KW Diesel Generator manufacture by Caterpillar, model D 39 (1)
26. OH Cooling water systems consist of 11'x8' aluminum tank, pump, filter, heat exchanger and piping.
27. OH Dummy load consist of copper bus and control cables.
28. Obsolete 480 V Motor Control Center
29. Two (2) Controls/Instrument panels for cooling water.
30. Water Cool Bus and six concrete blocks.
31. S-1 enclosure, contains copper bus bars and resistors
32. HALON fire extinguisher system
33. Two air conditioning units, Carrier, model # 50D024600. Each weights 3,000. Lb.

PICTURES

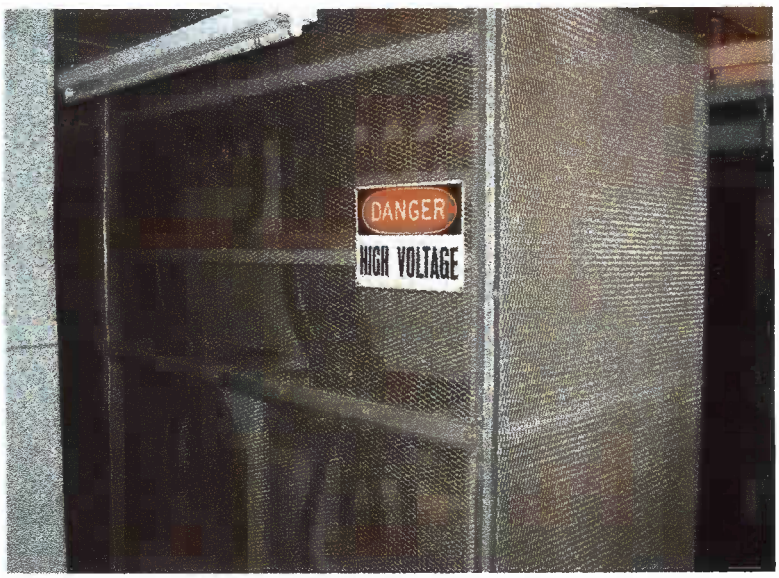
MG SETS OVERVIEW



MG – FLYWHEEL

ITE SWITCHGEAR model FB-60 High Speed DC breaker

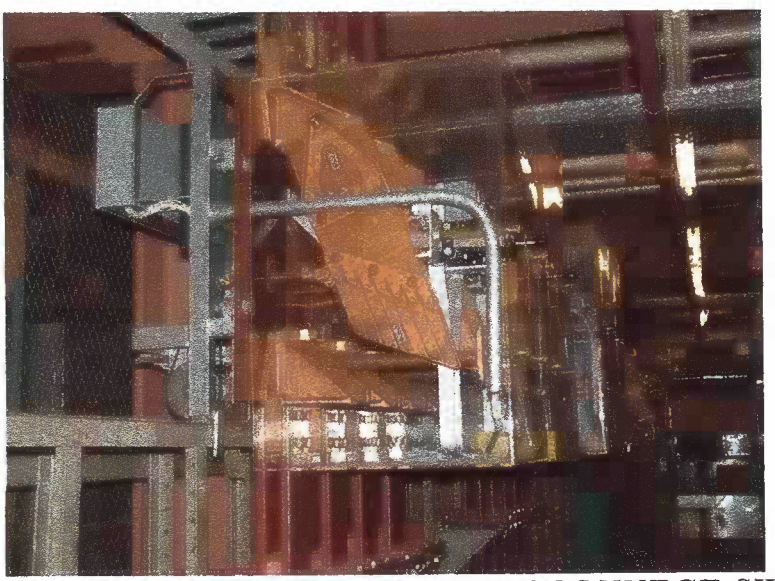
ITE SWITCHGEAR model KF A



DISCHARGING RESISTOR LOAD

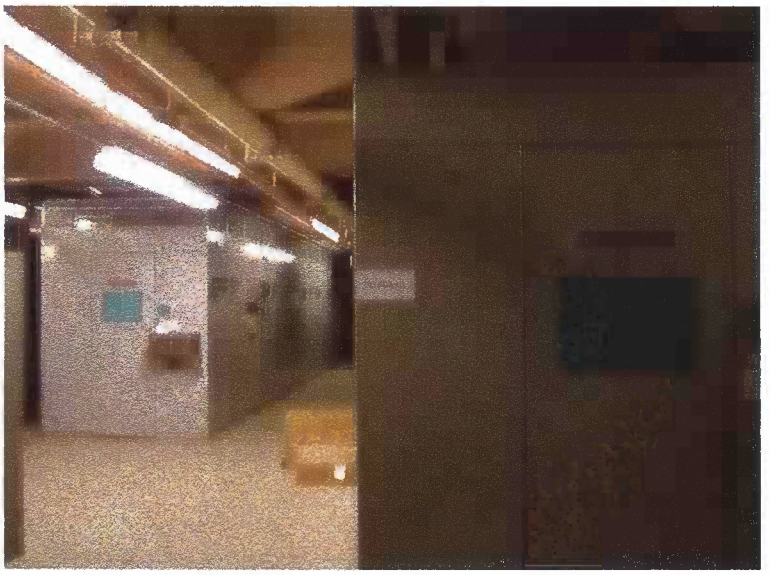
DC COPPER BUS

TYPICAL ROUTE OF DC BUS FROM GENERATOR PIT



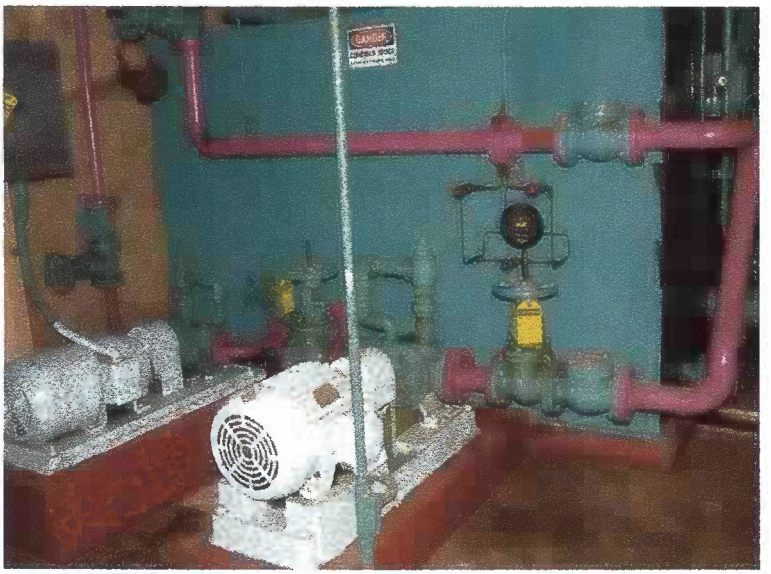
MEMCO - MOTORIZED DC DISCONNECT SWITCH

DUPLEX PANEL BOARD

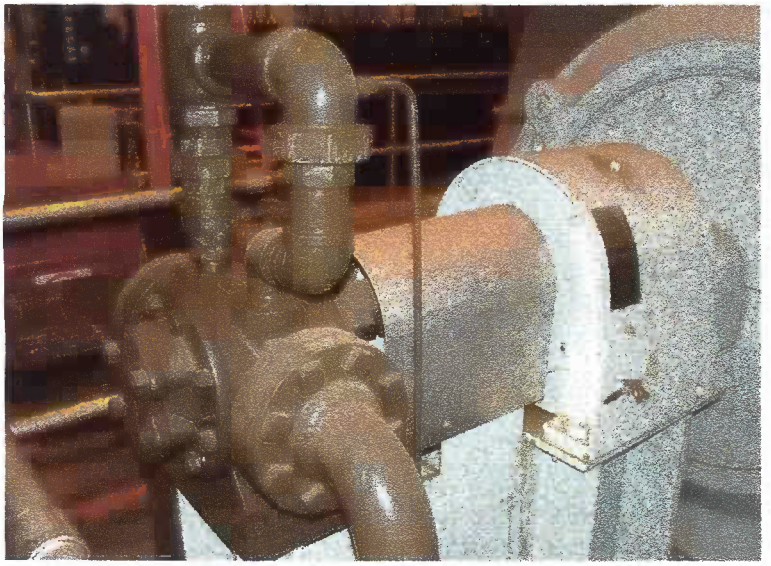


DC PANEL BOARD

FREQUENCY CONVERTER



AC / DC BEARING OIL PUMPS



SHAFT DRIVEN BEARING OIL PUMP

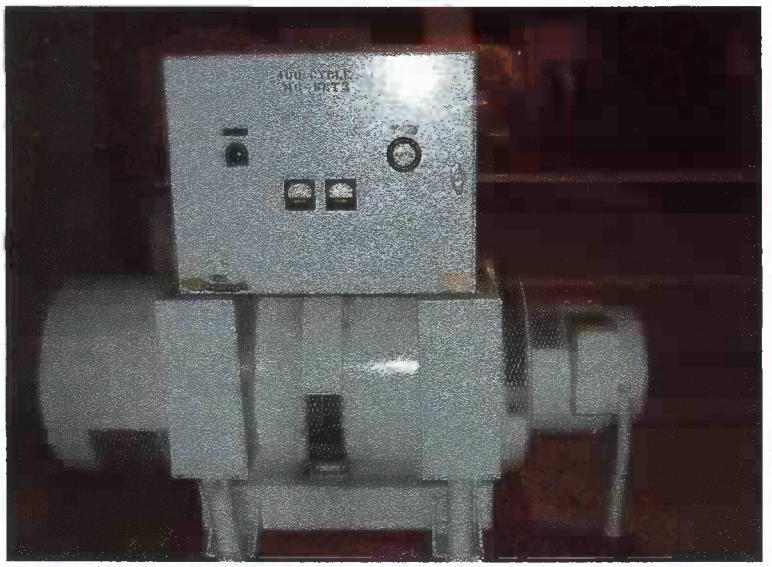
BEARING OIL TANK / FILTER AND HEAT EXCHANGER

TYPICAL GENERATOR BLOWERS & HEAT EXCHANGER

AC / DC RELAY BOARDS

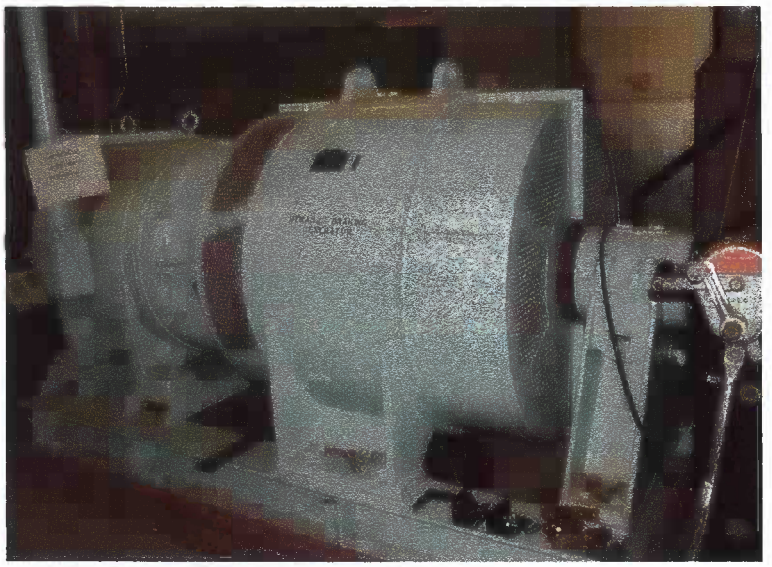
TRANSFER CONTROL PANELS

MOTOR GENERATOR EXCITER SETS



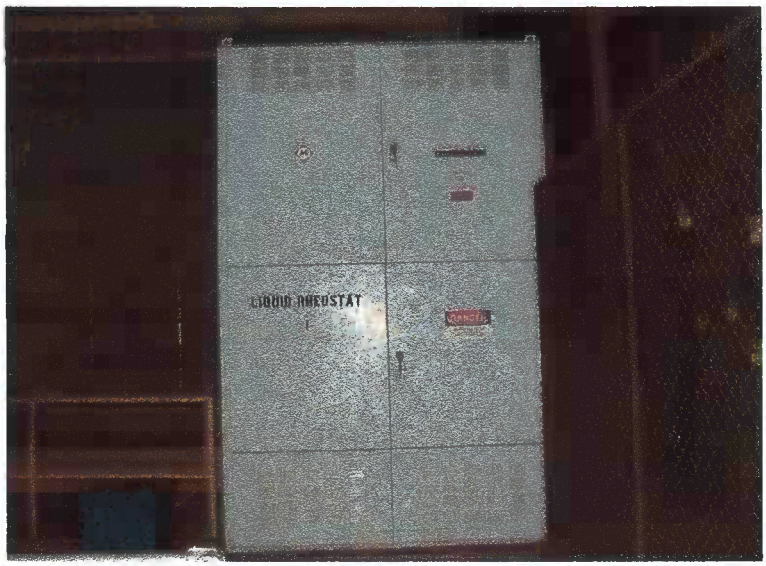
KATO – 400 CYCLE – MG SET

ALLIS-CHALMERS 400 CYCLE MG SET

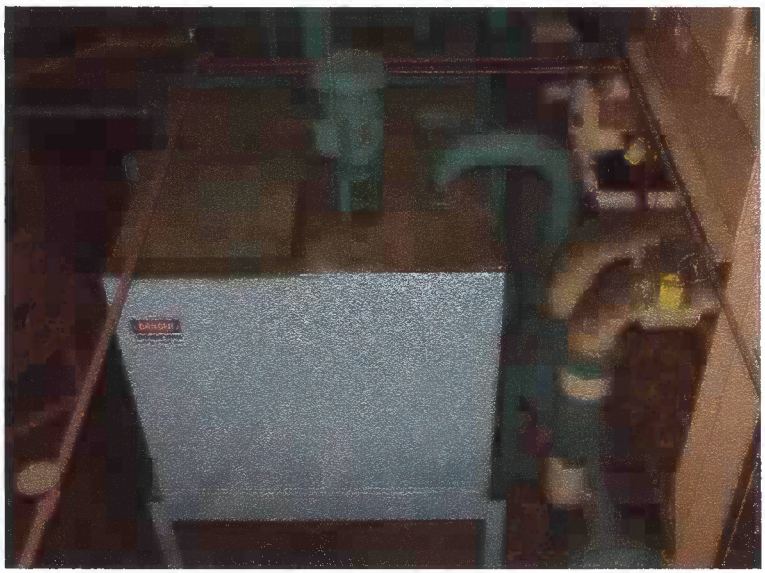


DYNAMIC BRAKE GENERATOR

DYNAMIC BRAKE SWITCHGEAR



LIQUID RHEOSTAT (TOP)



LIQUID RHEOSTAT (BOTTOM)

CARDOX – FIRE EXTINGUISHER SYSTEM

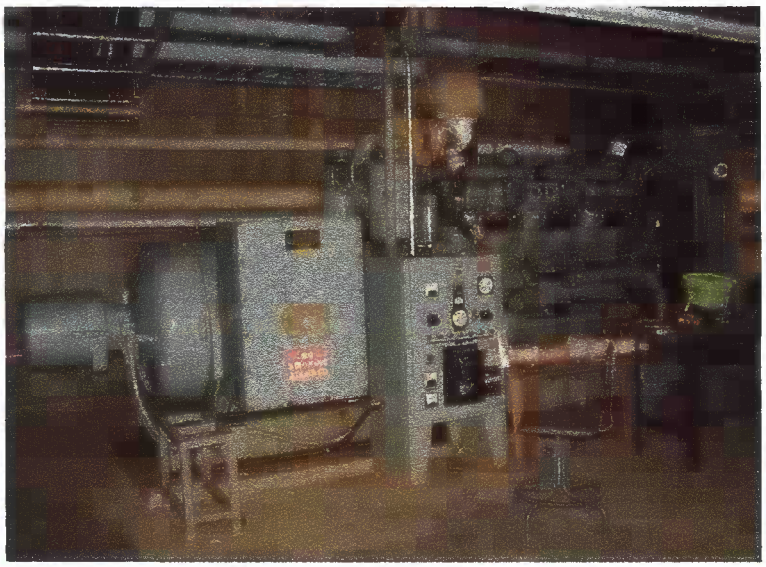
VOLTAGE REGULATOR

IMPERIAL MG SET

WORTHINGTON CHILLER MOTOR

WORTHINGTON COMPRESSOR & GEARBOX

WORTHINGTON CONDENSER (TOP) & EVAPORATOR (BOTTOM)

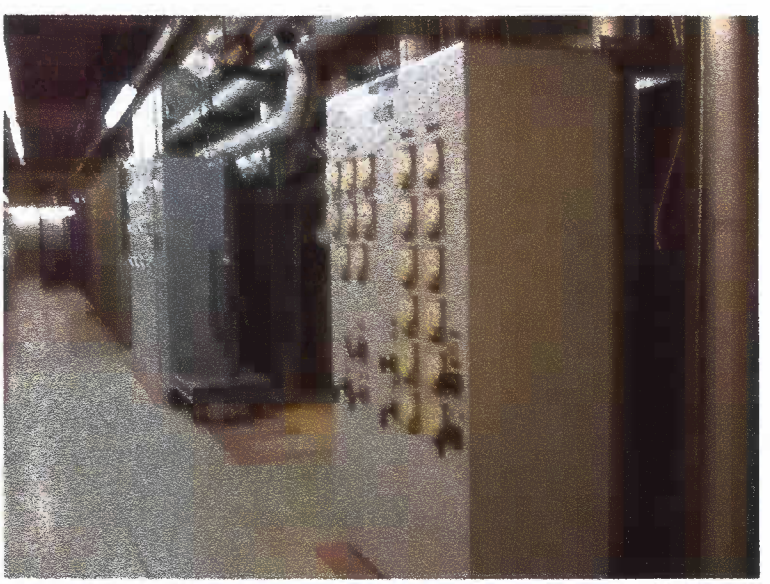


350 KW DIESEL GENERATOR – CATERPILLAR MODEL D39 (1)

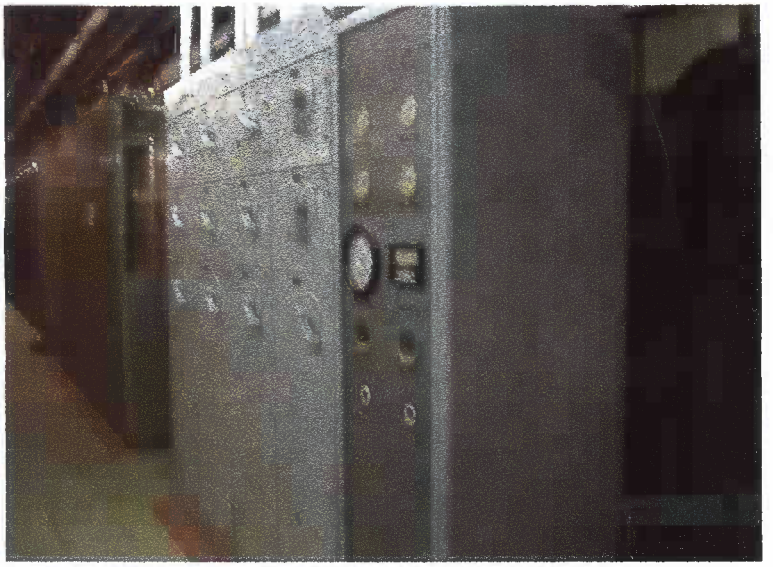
OH COOLING WATER SYSTEM

OH DUMMY LOAD

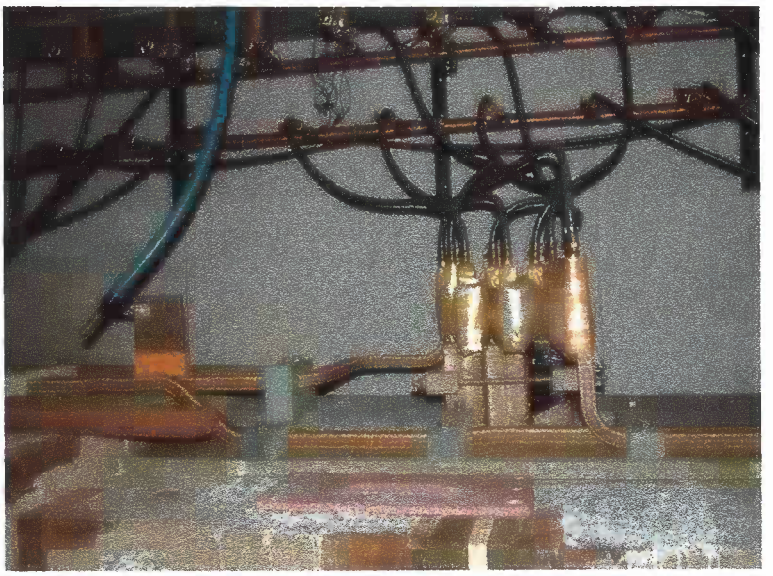
MOTOR CONTROL CENTER



CW Instrumentation / Control Panel

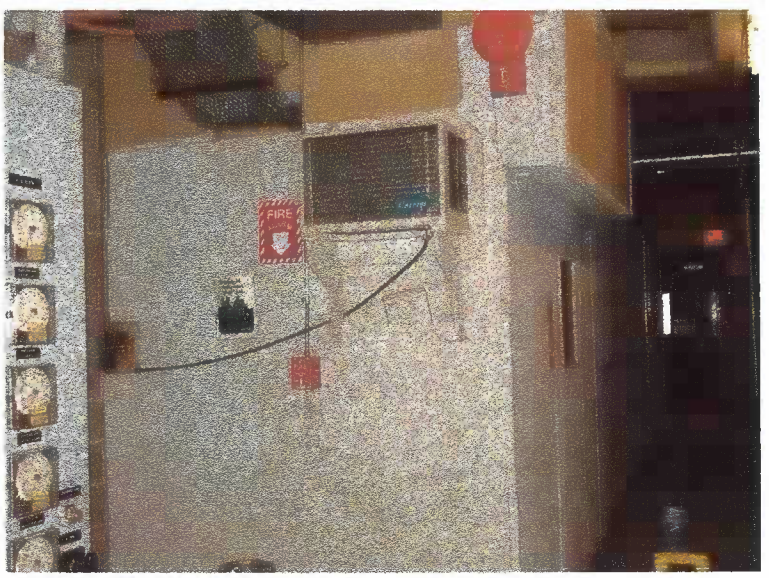


CW Instrumentation Panel



WATER COOL BUS (filter coil)

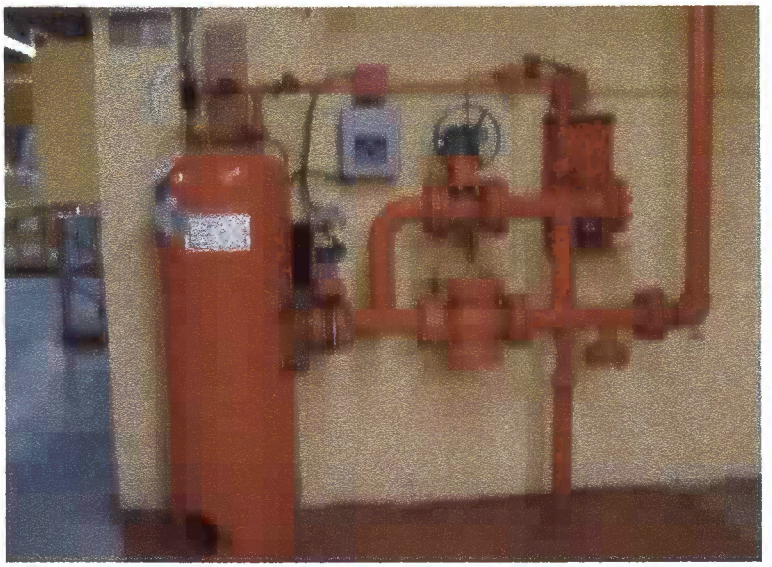
WATER COOL BUS (S-1 filter coil) ENCLUSURE



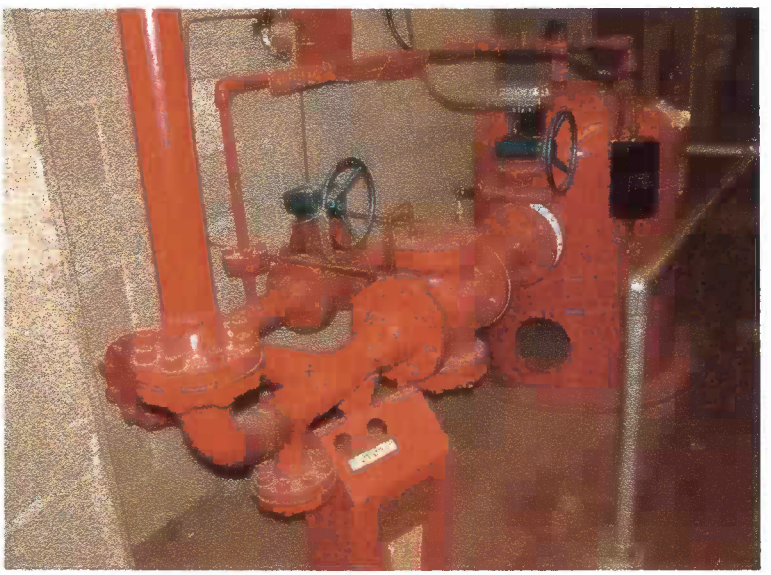
S-1 Enclosure

Inside S-1 Enclosure

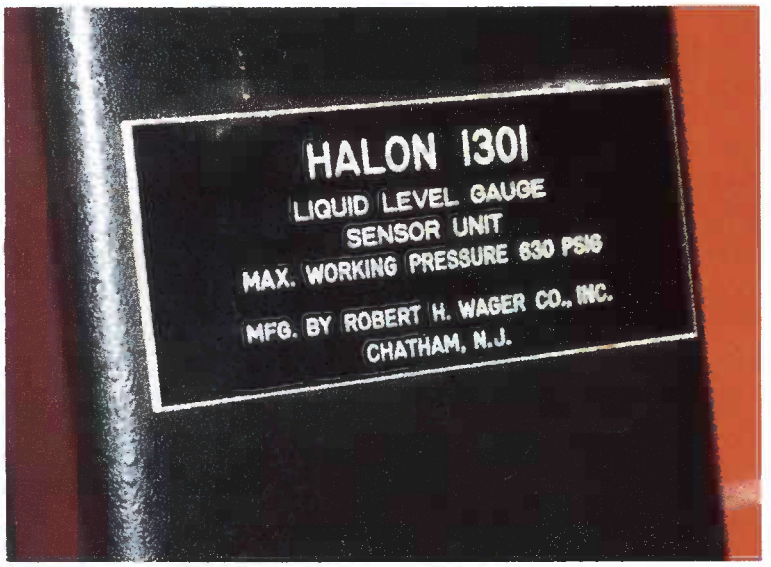
Inside S-1 Enclosure



HALON System – MG floor



HALON System – CS basement


HALON 1301
LIQUID LEVEL GAUGE
SENSOR UNIT
MAX. WORKING PRESSURE 630 PSIG
MFG. BY ROBERT H. WAGER CO., INC.
CHATHAM, N.J.

Appendix III

MG SETS – TECHNICAL DATA

Section 1

INTRODUCTION:

The C-Site MG (Motor Generator) sets became operational in 1961. They were built by C. Stellarator Associates (CSA), a group of major industrial contractors, including Allis Chalmers, Radio Corporation of America (RCA) and others. It was purchased under the Atomic Energy Commission Prime Contract No. AT (30-1)-1238, Subcontractor No. 32 dated 9/2/1957. The total purchased cost for the large MG sets is $6,040,000.

These are three (3) identical large MG sets and one small (special) MG set. Each large set consists of 7,000 HP would rotor motor, four (4) direct current generators, and a flywheel weighs 96 ton. Each generator is rated at 750 VDC and 5,075 DC current continuous (steady state). They are capable to pulse at 440% of the steady state current (22,300amps DC) for an equivalent square wave of two (2) seconds with a duty cycle of 5 percent. This would be more than 16 million watts per generator.

The twelve generators and all associated controls can be programmed to any of six different research areas in many series and parallel combinations.

The public utility is barely affected during pulse operations. This is explained by the fact that, during a pulse, the rotor circuit of the 7,000 HP motor has a sufficiently high electrical resistance (due to the massive pulse liquid rheostats) that as electrical energy is produced by the generators it is removed from the flywheel (as mechanical energy) instead of from the utility. As the flywheel slows down during a pulse, the generator controls act to maintain a constant current into the research load. After a pulse, the liquid rheostats gradually allow more energy to enter motor and bring the flywheel back up to speed and ready for the next pulse.

Section 2

MG TECHNICAL DATE

SMALL MG SET

One motor generator set consists of:
- Drive motor
- Two dc generators
- Stored energy flywheel
- Exciter MG set
- Operation Characteristics

1.1 – Drive Motor Name Plate:
Manufacturer Allis – Chalmers
Induction motor, 1500 HP, 885 Pull load RPM, 4160 VOLT, 185 A, 3-Phase, 60 C/S
Rotor: 1000 volts, 675 Amp
Type ANY
Liquid Rheostat: Type 257, size 3, 1500 HP, rated KW 250, secondary Volt 1000, sec Amp. 675

1.2 – Generator Name Plate:
DC Generator, 1090 KW, 430 volt, 885 rpm
2540 Amps, Shunt wound
Temp rise 100% load wdgs 70°C, comm. 85 °C
Excitation 250 volt, 58.5 Amps
Type HCC

1.3 – Stored energy Flywheel weight 9.4 ton

1.4 – Exciter set consist of:
1.4.1 Drive induction motor
NEMA Design B Service factor at rated volt & freq. 1.15
Type AP Frame 445Z
24 hrs. 40°C rise Locked KV-A code F
75 HP, 1750 RPM, 90 A, 440 V, 3-PH, 60 c/s

1.4.2 Two DC generator

Frame EB-127	Shunt wound
50 KW	24 hrs, wedgs. 70 ° Comm. 85° C
1750 rpm	F. L. Volts 250, 200 Amps

1.5 – Operation Characteristics

1.5.1 MAX PULSE RATING

Power	4,200 KW
Voltage	375 VDC
Current	11,150 ADC
Operating Speed	885-700 RPM

1.5.2 CONTINUOUS RATING

Power	1,090 kW
Voltage	430 VDC
Current	2,540 ADC
Speed	885 RPM

1.5.3 Energy Released in dropping from 100% to 80% speed for the set is 15.1 MJ

Large MG Sets

Name Plate:
Manufacturer Allis – Charmers

Induction motor, 7000 HP, 355 Full load RPM, 4160 Volt,
890 A, 3-Phase, 60 C/S
Rotor: 2180 volt, 1433 Amp
Rise temp, at F.L. 70 °C
Type ANY

Liquid Rheostat type 257, size 6, 7000 HP, rated kW 1250 cont., sec. volt 2180, sec. Amp. 1435. The liquid rheostat is used during startup of the MG sets and for speed control during pulsing. Prior to start of a pulse, the liquid rheostat electrodes are positioned to establish the speed torque curve in which the motor will follow during pulse interval. The speed torque curve selected is such that the MG set flywheel will make its energy contribution to the pulse during a 20% drop in MG set speed.

DC Generator, 460 kW, 800 volt, 355 rpm 5075 Amps, Shunt wound, HCC type Temp. rise 100% load windings 70 °C, commutator 85 °C, Excitation 250 v, 152 Amps.

2.4 Exciter set consist of four DC generator driven by induction motor
Type AW Frame 30BS8
24 hrs. 40 °C rise Locked KV-A code F
300 HP, 1775 RPM, 37.5 A, 4160 V, 3-PH, 60 c/s
DC generator
Frame EB-127 Shunt wound
50 KW 24 hrs. windings, 70 °C, commutator
85 °C
N.L. Volt 250, F.L. Amps. 200

MG General Description:

There are three large MG sets, each large set consists of:

7000 HP, 4160 v, drive motor (wound rotor), equipped with liquid rheostat
Four (4) DC generators
96 ton flywheel.
Any set can be configured for parallel, series of combination,
Control system consist of 6 programmed comparitors for each individual load
DC bus distribution included 9 in2 copper bus, High speed breakers, Resistor discharge breaker and safety disconnect switch (not load interruption) which ground the load when it is in open position.
6 ground fault detectors programmed for each load based on load voltage distribution with respect to generators configuration (one per each load configuration)

Technical Summary

MAX, PULSE RATING PER EACH GENERATOR:
Power 16.67 MW
Voltage 750 VDC
Current 22.3 KADC, or an equivalent square wave of 2 sec. with duty cycle of 5%
Pulse length: Depend on the load current, load impedance
Operating speed range 350-280 RPM
Max. dv/dt 1300 V/SEC
Energy/released/shaft/Pulse 137.6 MJ
DC Ripple < .01 %

CONTINUOUS (STEADY STATE) RATING
Power 4.06 MW
Voltage 800 VDC

Current	5,075 KADC
Speed	350 RPM

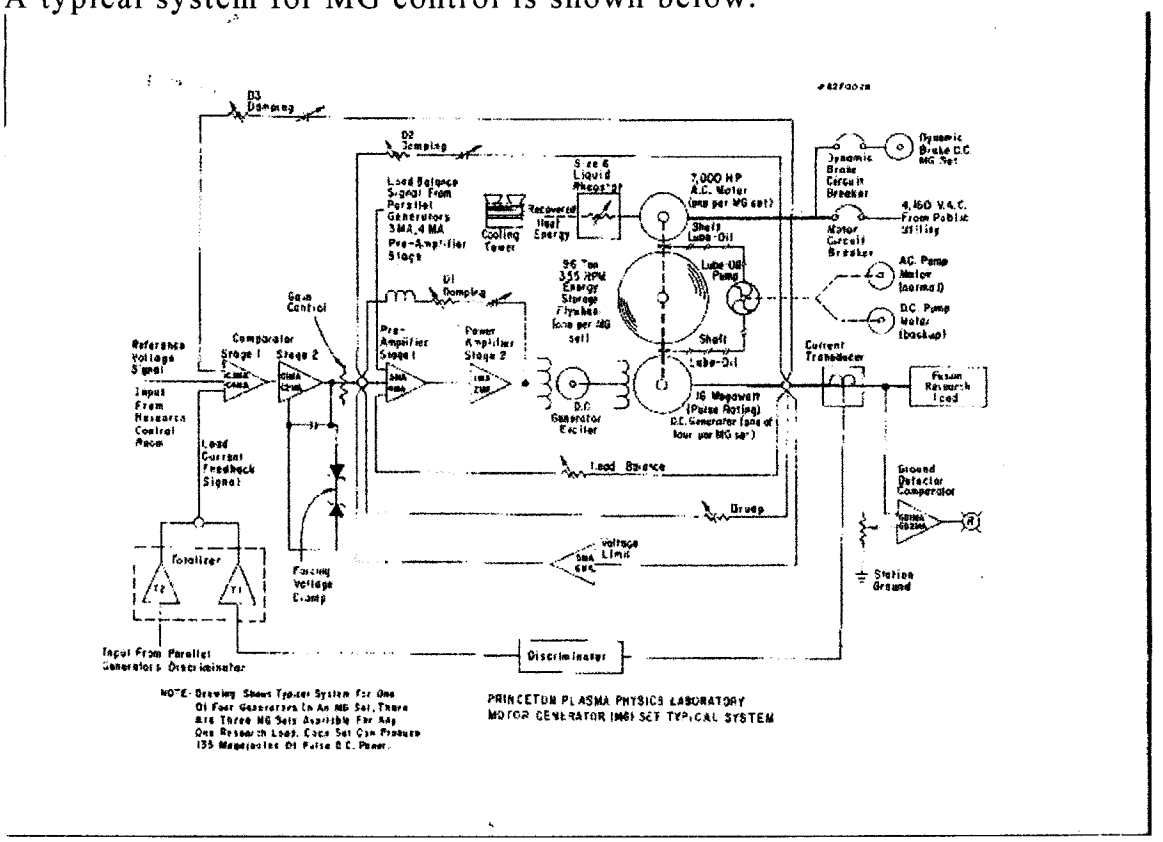
Section 3

MG Lube Oil System
The system is manufactured by Ritter Engineering Co., and functions as follows:
Oil is returned by gravity through strainer to the dirty oil compartment of the baffled oil receiving tank.
Prior to start-up of MG set, oil is picked up by the AC & DC motor driven pumps supplying oil to the system. When the oil flow attains 50 GPM, the DC flow switch opens, cutting out the DC motor driven pump. Once the AC motor driven pump delivers sufficient oil to all bearings, the MG set can started. The MG shaft driven and AC motor driven pumps are running. When the shaft driven pump delivered 95 GPM to the system, the AC flow switch opens cutting out the AC motor driven pump and allowing the MG shaft driven pump to supply oil to the system. Pumps are of the positive displacement type and are protected by built-in relief valves set a 75 psi with he exception of the DC relief valve set at 50 psi. The oil is then pumped through the filter.
HILCO HYFLOW oil filter, type F equipped with inlet and outlet pressure gauges and six 5 micron filter cartridges and dirty filter alarm set to operate on a differential pressure of 18 psi.
The heat exchanger is a single pass design, sized to maintain the outlet temperature of the oil at 98 °F. The oil flows to the system and is monitored by system relief valve set at 40 psi.
Pressure gauges and temperature gauge register system inlet and outlet pressure and temperature at the cooler.
Filter and cooler can be by-passed for maintenance.
A low level switches to give warning of oil level below 2/3 full.
Temperature control switch set at 100 °F to maintain the temperature of the immersion heater.

Section 4

Typical MG Controls Configuration

A typical system for MG control is shown below.



Section 5

Current Transducers

Manufacturer	Magnetic Inc.
Current Rating	25000/5
Accuracy	+/-1% full scale over AC voltage range 216 to 264, 60 c/s and 5 ohm control circuit burden.
Supply Voltage (Nominal)	240 volts, 60 c/s
Control Circuit Burden	5 ohms
Special Winding	Current directional sensing winding

Current Rating	5000/2 amps DC
Control Circuit Burden	10 ohms

Current Rating	10,000/2 amps DC
Control Circuit Burden	10 ohms

Section 6

Totalizers

Manufacturer	Magnetics, Inc.
Windings	3-15 turn 5 Amps. 4-5 turns 5 Amps.
Supply Voltage	120 volts, 60 c/s
Current Rating	+/-1% full scale over AC voltage range 108 to 132, 60 c/s and 4 ohm control circuit burden

Section 7

MG Duplex Switchboard
The MG duplex switchboard is located on the mezzanine of the MG building at C-site. It is the control station for the MG room operator. The DC generator power section consists of panels 5 through 17. All MG room operations involving the generator control are performed with controls mounted on the section. Panel 5 of this section mounts:
The metering and the start-stop controls for the control power MG Sets and dynamic braking MG set.
On-off controls for totalizes power circuits.
Mimic bus for indicating normal and emergency power flow.
KS4 MG room area access key interlock.

Panel 6 through 9 mount the operating and monitoring devices and relays associated with each generator power loop. The operating controls consist of:
On-off switches for transductor power supplies
Generator field contactor control switches.
Resistor circuit breaker control switches
Hi-speed DC circuit breaker control switches.
The monitoring devices consist of:
Mimic bus for each generator power loop for indicating generator assignments to operating areas.
Indicating and recording metering of generator volts and amps
Annunciators for generator power loop function.
Generator temperature recorders.
The relays are used in closing and tripping circuits of he resistor circuit breakers and hi-speed dc circuit breakers and to perform miscellaneous auxiliary functions in the area of recording and "operate-arming."

In addition to the devices referred to above, the following control switches are mounted on the DC generator power section:
Permissive control switches
Test polarity control switch CSTP

Comparator selector control switch CSCS
Test voltage control switch CSTV

Panels 10 through 16 mount the operating and monitoring devices and relays associated with the main MG sets and the exciter MG sets. The operating devices consist of the following control switches:
5M86 lockout control switch
CS4AU master auxiliary control switch
CS52 wound rotor motor circuit breaker switch
Dynamic braking control switch
Liquid rheostat raise-lower controls switch 1CS.
Liquid rheostat manual-automatic controls switch 2CS.
Exciter MG set circuit breaker control switch
Exciter drive ammeter control switch
The monitoring devices consist of indicating ammeters and voltmeters for the main MG set and exciter set drive motor; Annunciators for MG set auxiliary functions; protective relays and RTD for drive motor windings, bearings, and air-flow temperatures.

Section 8

DC Switch Board
The DC switchboard is located on the 1st floor of MG room and consists of two main assemblies. One assembly mounts magnetic amplifiers and associated control devices for main generators #1, 2, 3, 4, 9, 10, 11 and 12; load associated comparators 1, 2, 3, 4; 400 cycle regulator controls; and 125 volt dc exciter controls. The other assembly mounts magnetic amplifiers and associated control devices for main generators #5, 6, 7, 8; and load associated comparators #5 and 6. The dc switchboard is of a tunnel type construction with not exposed live parts on the front or rear sides. Access to the interior is obtained through lockable doors on each end. Layout of all devices is symmetrical, based on individual generator and comparator circuitry. Instruments mounted on the front side permit monitoring the voltage and current of each generator and the control circuits of the magnetic amplifiers.

Section 9

Transfer Cubicles
The flexibility incorporated into the generator control permits assignment of generators to any operating areas. The purpose of the transfer switching cubicle and transfer relay cubicle is to group in one location all the switching and relaying devices required for making generator control assignments operating plan. Therefore, shifting of generators controls between operating areas requires simply a transfer switch manipulation. Whenever the operating plan is changed, certain portions

of the transfer cubicle panels require rewiring or reprogramming. The design of the transfer cubicle panels are such that rewiring only required reconnection between terminal strips.

Transfer Switching Cubicle

Transfer switching cubicle is a three section cubicle. Each section has double front and rear doors with the front doors key interlocked for limited access to the transfer switches. The generator control transfer switches front doors key interlocked for limited access to the transfer switches. The generator control transfer switches 1-TFS etc. and transductor transfer switches 1-TS etc. are mounted across the top of the transfer switch cubicle panels. Directly below the transfer switches are horizontally mounted terminal strips for programming transfer switch position with respect to operating plan requirements. The lower half of the transfer switch cubicle panels, both front and back, have vertically switch mounted terminal strips to which transfer switch circuit connections and permanent interconnections are made. The terminal strips are arranged so that high voltage circuits, ac circuits and dc circuits are separately grouped. The generator transfer switches 1-TFS etc. consist of three thirty-stage switches operated simultaneously from a common hand wheel. The generator transfer switches have an "off" position and three operating area positions.

The transductor transfer switches 1-TS, etc. are use to switch generator control between the 25,000/5 Amp current transductors. The transductor transfer switch 1-TS etc. has 15 stages and three openings positions, high-off-low. In addition to providing the switching between transductors, six stages of 1-TS etc. are used for programming all transfer switches with respect of area assignment of generators.

Transfer Relay Cubicle

The transfer relay cubicle is a three-section cubicle. Each section has double front and rear doors. The front of each section mounts the dc summing relays associated with the generator control for a given operating area. The upper part of the rear of each section mounts the ac relays associated with the operating area. The entire cubicle area below the ac relays is used for terminal strips arranged on a functional basis for programming control circuits. Viewing the relay cubicle from the rear, the left hand section mounts the terminal strips for programming the totalizers. The center section mounts the terminal strips for programming comparator damping circuits and generator load balance circuits. The right hand section mounts the terminal strips for programming the generator magnetic pre-amplifier control windings.

Section 10

Current Regulator

General

The dc power supply is cable of continuously supplying the losses of the load. The energy storage and ratings of the main MG sets make it possible to supply the average continuous power on an equivalent 2 sec. flat top pulse and 5.15% duty cycle basis to produce a steady state magnetic field of 55,000 gauss. The equivalent 2 sec. flat top pulse consists of 1 second steady state at a maximum per generator current of 22,300 amperes and a total of 1 second rise and fall time to and from the steady state value. During pulse flat top the current is regulated to +/- 1% of the maximum current of 22,300 amperes. To obtain the required accuracy in the regulation of flat top current, closed loops current regulators having a loop gain of approximately 50 are furnished. The current regulator can be divided into two basic sections namely a comparator section and an excitation and measuring section. To supply and regulate the power to a given load, one comparator section is required and as many excitation and measuring sections as there are generators assigned to the load.

Comparator Section

The comparator section and its components are load associated. There are six comparators which mean's that six separate loads can be simultaneously controlled. In the comparator section a reference signal proportional to the desired load current is compared with a measure of actual load current to produce an error or regulating signal output to the excitation and measuring sections. Two stages of 400 cycle magnetic amplifiers are used in the comparator section. Negative feedback is used to keep the time constant short and to minimize the effect of magnetic amplifier gain changes on overall comparator accuracy. The arrangement of generators and loads depends on the load current and voltage requirements. The generator can be arranged in a series with the load or in parallel or series parallel combination. In parallel series combination, one group of parallel generators is taken as a reference group and a current feedback signal is brought to the comparator from each of the paralleled generators of the group. Since the comparator reference signal is based on a maximum generator current of 22,300 amperes some means of matching the total current feedback from the paralleled generators must be available. The comparator totalizer provides this matching means and accomplishes its purpose in the following manner:

A 300 ampere turn input to the totalizer will produce an output which will balance in the comparator pre-amplifier, a reference number of ampere turns equivalent to 22,300 amperes from one generator. The totalizer has three 15 turn windings and three 5 turn windings. If one generator is used, all 60 turns are connected to the reference generator transductors. For two generators in parallel, each reference generator transductor feeds 30 turns on the totalizer. For these generators in parallel, each reference generator transductor feeds 20 turns on the totalizer. For four generators in parallel each reference generator transductor feeds 15 turns on the totalizers. Since the control is reversible, push-pull magnetic amplifiers are used and two totalizers, one for each direction of bus current are also furnished. Damping for the comparator section is obtained through a series of RC network from reference generator voltage to comparator pre-amplifier damping winding.

Excitation and Measuring Section

The excitation and measuring section and its components are generator associated, and in response to the error of regulating signal output from the comparator section, produce the generator voltage necessary to sustain a desired generator current. In order to obtain the fast response required to keep pulse rise and fall times as short as possible, special attention was given to the design of the dc machines and the selection of the excitation amplifiers and current measuring elements. The field yokes of exciter and main generators are laminated to obtain field time constants of .25 and 1.85 seconds respectively. The magnetic amplifiers are 400 cycle in order to keep their time constants short. In addition, the voltage ratings of the exciter and magnetic amplifiers were selected to provide a generator field forcing capability of 9 to 10 times the normal full output steady state voltage required on the generator field. Exciter voltage is limited to 400 volts during the forcing period. A further improvement in time constant of the excitation components was obtained by the use of droop or negative feedback around the generator exciter and its magnetic amplifiers. The negative feedback loop also helps to minimize changes to system accuracy due to changes in exciter and magnetic amplifier gains. With the high forcing capability of the control system, generator voltage limit magnetic amplifiers were made part of the excitation and measuring section to limit generator peak voltages to 865 volts. The current measuring element used to produce the current feedback signal for the comparator is a series connected bus bar type current transductor to current changes is practically instantaneous and its accuracy is +/-1 % of full scale rating over a wide range of control circuit burdens and a supply voltage variation of 1/-10%. In order to obtain an output which is reversible with the direction of bus current a direction sensitive winding is furnished on each transductor core. The

direction sensitive transductor windings control a transistorized saturating, bi-stable multi-vibrator which switch switches the transductor output to the comparator totalizer corresponding to the direction of bus current. Damping signals in the excitation and measuring section are taken through series RC networks from the power magnetic amplifier output and the generator output to separate damping windings on the magnetic pre-amplifiers.

Section 11

HI-Speed D.C. Circuit Breaker

Manufacturer	ITE
Type	FB-60
Rated Voltage	1000 volts dc
Rated Continuous Current	6000 amps dc
Tripping Range	10,000 to 30,000 amps
Normal Trip Setting	27,500 amps
Interrupting Rating	250,000 amps
Closing Power	115 volts ac
Tripping Power	125 volts dc
Instruction Bulletin	ITE-1B-5911
Total Quantity	16 Breakers

Section 12

Resistor Circuit Breakers	
Manufacturer	ITE
Type	KF
Rated Voltage	500 volts dc
Maximum Design Voltage	700 volts dc
Rated Current	1600 amps dc
Short-Time Current on Main Contacts	75,000 amps dc
Interrupting Current at 700 volts dc on Main Contacts	16,000 amps dc
Momentary & Closing Current Rating:	
(Peak amperes) a-c fault on Discharge Contacts	9,600 amperes
½ second rating, amperes, on Discharge Contacts:	7,200
Current	1,600 amps dc
Voltage	500 volts dc
Closing Power	230 volts dc
Tripping Power	125 volts dc
Instruction Bulletins	ITE
Installation, Operation & Maintenance Specific Instructions	IB-6000-G
for KA, KB, KC	IB-6000-K
Draw-out Mounted Breakers	IB-5626
Type KF Field Discharge Circuit Breaker	
Type R14 Control Relay	IB-5412-A
Type L2 Auxiliary Switches	IB-5504-A
Extendible Escutchem & Type P1, P2 & P2 Switches	IB-5512
R14 Relay Renewal Parts	RP-1003-R14
Shunt Resistors	Euclid Electric & Mfg.Co.
Manufacturer	GV-302
Type	1500 volt dc
Rated Voltage	375 °C rise 750 amps dc
Rated Current Cont.	500 °C rise 3 sec. 30,000 ADC
Rated Current Pulse	.015 sec. 75,000 amps dc
Resistance Ohms 25 °C	.02 Total +/- .001
Instruction Bulletin	Type GV -302 Shunt Resistors

Section 13

400 Cycle MG Control Supply

There are two sets, only one is used and the other is for backup. The followings is the name plate data for each:

1 – Allis-Chalmers Unit

Drive Motor

Manufacturer	Allis-Chalmers
NEMA Design	B
Service Factor at rated volts & Feq.	1.15
Type	AW
Frame	23BS8
Temp, Rise	24 hrs. 40 °C rise
Locked KV-A	Code F
Power	150 HP
Speed	1770 rpm
Current	179 amps
Voltage	440 volts, 3 phase, 60c/s
S/N	7-515-28103-4-1

AC Generator

Type	AWB
Frame	26AS8
Power	75 kw, 125 kva
Temp. Rise	24 hrs. 50 °C rise
Power Factor	60%
Field	24 hrs. 50 °C rise
Current	164 amps.
Voltage	440 volts, 3 phase, 411 c/s
Speed	1770 rpm
Excitation	218 volts, 11.3 amps max.
S/N	7-5153-28103-3-1

KATO LIGHT

Power	12 kw, 12 kva
Voltage	115/230 volts, 60 c/s, 1-ph, 4
Current	wire
Temp.Rise	54.4
Speed	70 °C
Alt. Field Current	1800 rpm
Model	.72 amps
Type	12TD1
DC Exciter	K-14
Model	
Type	.65XL4E
S/N	13702-Brushless
Manufacturer	63986-8
	Katolight Corp.

DC Generator

Frame	
Power	EX-80
Winding	10kw
Temp. Rise	Flat compound wound
	24 hrs. winding 50 °C,
Speed	commutator 65 °C
Current	1800/1770 rpm
No Load Voltage	80 amps
Full Load Voltage	125
S/N	125
	7-5380-28103-2-1

2- Kato Unit

2.1 Reverse Field AC Generator

Power	75 kw, 125 kva
Voltage	254/440 volts, 3 ph,420c/s, 4 wire
APT.	164.2
Power Factor	.6
Speed	1800 rpm
Model	75VR9X
Type	15026
S/N	64114
Temp. Rise	50 °C
Insulation Class	B
Exciter	Brushless
Model	4JL4E
Type	14431
Power	4kw
Voltage	50 volts
Field Amp	4.8 amps

2.2 Sync. Motor

Power	150 HP
Voltage	220/440 v, 3 ph, 60 c/s, 9 wire
APT.	334/167
Power Factor	1
Speed	1800
Model	150LR9E
Type	15027
S/N	64114
Temp Rise	50 °C
Insulation Class	B
Exciter	Brushless
Model	4JL4E
Type	14662
Power	4kw
Voltage	100 volts
Field Current	2.3 amps

2.3 DC Generator

Power	10 kw
Current	80 amps.
Voltage	125 volts
Field Voltage	125 volts
Field Current	1.4 amps
Winding	Compound
Temp. Rise	50 °C
Model	10XA69
Type	15025
S/N	64114

Section 14

Dynamic Brake Set	
Induction Motor	
Manufacturer	Allis-Chalmers
Nema Design Type	AW
Frame	30FS6
Temp. Rise	24 hrs. 40 °C
Locked KV-A	Code F
Power	250 HP
Voltage	480 volts, 3 phase 60 c/s
Current	284 amps
Speed	880 rpm
S/N	7-5151-27282-7-1
Generator	
Manufacturer	Allis-Chalmers
Power	150 kw
Voltage	50 volts
Current	3000 amps
Speed	880 rpm
Winding	Shunt Wound
Temp. Rise	2 hrs.wdgs. 75°C, Commutator 85 °C
Excitation Voltage	250 volts
Excitation Current	13.5 amps
Type	HC
S/N	160218

Section 15

MG Fire Protection System

All motor generator sets are equipped with low pressure carbon dioxide system for fire protection. Low pressure carbon dioxide is employed in Cardox Fire Extinguishing as the extinguishing agent because of its ability to dilute and displace the air which is so vital to combustion. The actual application of carbon dioxide does more than merely dilute and displace the air in the atmosphere. Low temperature, low pressure carbon dioxide has a high yield of snow during the discharge thus reducing the temperature of the combustible. It also absorbs heat from the flame itself and thereby reduces the flow of heat from the flame to the combustible material. The "total flood" method is used since each MG set has its own enclosure

Name Plate:

Manufacturer:	CARDOX
Tank Capacity	4 Tons
S/N	L881
Model	182562-2

APPENDIX IV

ESTIMATED WEIGHT FOR MG SETS & OTHER EQUIPMENTS

Quantity	Item Description	Unit weight lbs.	Total weight lbs.
3	Flywheel with its shaft	191,400	574,200
3	Flywheel cover	6,600	19,800
12	Generator armature	308,800	3,705,600
12	Generator Field	201,600	2,419,200
3	MG set base	58,000	174,000
6	34x27 Pedestals	33,000	198,000
12	30x24 Pedestals	61,600	739,200
3	24x28 Pedestals	15,600	46,800
3	Motor Stator	48,500	145,500
3	Motor rotor	53,700	161,100
3	Slip ring	950	2,850
45	Coolers & Blowers	24,700	1,111,500
3	Liquid Rheostat & heat exchanger	7,500	22,500
4	L/R Control cabinets	800	3,200
16	Switch gear FB-60	400	6,400
16	Switch gear kF	400	6,400
16	Discharging Resistors	200	3,200
12	Exciters generator	1,825	21,900
3	Exciter drive motors	3,500	10,500
3	Exciter set base	2,400	7,200
1	6" bearing pedestals	900	900
2	8" Bearing pedestals	1,400	2,800
2	12" Bearing Pedestals	6,500	13,000
1	Flywheel with shaft	18,700	18,700
1	flywheel cover	1,400	1,400
1	Motor Stator	9,000	9,000
1	Motor rotor complete	5,900	5,900
2	Generator armature	9,500	19,000
2	Generator Field	16,800	33,600
1	MG set base	15,500	15,500
1	Liquid Rheostat	4,500	4,500
2	Exciters generator	1,400	2,800
1	Exciter drive motor	1,100	1,100
1	Exciter set base	525	525
31	DC control panel boards	1,000	31,000
8	Transfer switch panels	650	5,200
10	AC / DC Relays panel boards	200	2,000
3	Oil Tank 8'x10'x6'	8,000	24,000
1	Small Oil tank	3,000	3,000
3	DC oil pump	125	375

3	AC oil pump	125	375	
6	Jacking pump 7.5 HP, 480 v	125	750	
1	DC oil pump	65	65	
1	AC oil pump	65	65	
2	Jacking pump 1.5 HP, 480 v	65	130	
1	Cooling water pipes	3,000	3,000	
1	Control & power cables	6,000	6,000	
1	Dynamic Brake MG set	12,600	12,600	
4	Dynamic brake swgr	1,600	6,400	
2	400 cycles MG set	3,000	6,000	
1	CO2 Fire extinguisher	8,000	8,000	
1	Voltage Regulator	1,000	1,000	
1660	Bus Tunnel East (1 19/32"x6")	35	57,270	
1751	Bus Tunnel West (1 19/32"x6")	35	60,410	
508	Bus from MG set # 1	35	17,526	
812	Bus from MG set # 2	35	28,014	
540	Bus from MG set # 3	35	18,630	
410	Bus from S-1 machine	35	14,145	
68	Bus on 1st Floor East	35	2,346	
170	Bus at MG basement	35	5,865	
368	Bus tunnel East (3/4"x5")	14	5,299	
340	Bus from Small MG set	14	4,896	
36	MEMCO disconnect switch	150	5,400	
2	Chiller's motor & cooler	14,700	29,400	
2	Chiller's bearing	1,200	2,400	
2	Chiller's compressor & associated pipes	8,500	17,000	
2	Chiller's evaporator & associated pipes	2,000	4,000	
2	Chiller's condenser & associated pipes	7,210	14,420	
1	350 KW diesel generator	25,550	15,550	
10	Allis Chalmers switchgears	1,200	12,000	
4	Reduced voltage starter	1,500	6,000	
2	Carrier air conditioning unit	3,000	6,000	
		Total estimated weight	9,944,306	lbs.
			4,972	**Tons**

APPENDIX V

MANUFACTURER REFERENCE MANUALS & ASSEMBLY DRAWINGS FOR HANDLING THE MG SETS

Reference Manuals

1. Allis-Chalmers Instruction Book "Three – 7000 HP Flywheel Motor Generator Sets for Pulse Duty – Each 66,800 KW @ 750 volts", Subcontract No. 32, A.E.C Prime Contract No. AT(30-1)-1238
2. C Stellarator Associates "Magnetic Field Power Supply Equipment Manual"
3. C Stellarator Associates" 1500 HP MG Set Equipment Manual" August 23, 1961
4. Ritter Engineering Co. File #12342 "105-130 GPM Circulating Oil System"
5. Allis-Chalmers Instruction Book one – 250 HP Motor Generator Set for Dynamic Braking Duty-150 KW @50 volts'
6. Allis-Chalmers Instruction Book "Control Power MG Set (400 cycle & D.C.)
7. ITE Low Voltage Switchgear Instructions for type KF Field Discharge Circuit Breakers (model A)
8. ITE Engineering Specifications for High Speed Circuit Breaker Type FB60
9. Transducer Manual
10. Allis-Chalmers instructions, type 257 liquid Rheostat for wound rotor motor secondary control

Reference Drawings

05-411-372 Pit Enclosure
05-411-412 Spreader bar Assembly
05-411-349 Shaft & Spider Assembly
05-505-473 Brush Rigging & Cover Assembly
05-505-427 General Assembly – 4060 KW, 800 v, 350 rpm, 5075 amps
05-505-626 Method of Handling 7000 HP Motor & Generator Arm
05-505-443 Bearing Pedestal Assembly for 30" x 24" Bearing Bushings
05-505-453 Bush Support & Cross Connection Assembly
05-505-437 Bearing Bushing Assembly 30" x 24" Split Spherical Seat
05-505-428 Bearing Pedestal Assembly for 34" x 27" Bearing Bushing
05-505-431 Bearing Bushing Assembly 34" x 27" Split Spherical Seat
05-505-318 Stator Yoke Assembly
05-505-258 General Assembly 1500 HP
05-505-315 Field Yoke Assembly
05-505-320 1500 HP MG Set - Outline
05-411-560 1500 HP MG Set - General Assembly of Flywheel & Shaft
05-505-696 1500 HP MG Set - Control Wiring Diagram
05-215-289 1500 HP MG Set - Winding Diagram
05-200-097 1500 HP MG Set - Winding Diagram
05-411-285 1500 HP MG Set - General Assembly

05-214-893 1500 HP MG Set - Connection Diagram DC Generator
05-411-393 1500 HP MG Set Pit Enclosure & Instrument Arrangement
05-505-446 Bearing Pedestal Assembly 24 x 28
05-505-448 Bearing Pedestal Assembly 24 x 28
05-505-570 Bearing Oil Piping Arrangement
05-505-585 Tech. Gen. Gear Box Arrangement
05-505-590 Tech. Gen. Gear Box Detail Assembly
05-505-618 4060KW Gen. Pit Air Cooler & Blower Arrangement
05-505-671 1090 KW Gen. Pit Air Cooler & Blower Arrangement
05-505-667 Bearing Oil Piping Arrangement
05-505-686 150 HP Motor Pit Air Cooler & Blower
05-505-837 Stator Yoke Assembly
05-505-309 General Assembly of Flywheel & Bearings
05-505-616 Control Wiring Diagram (3 sheets)
05-505-285 Outline MG Set
05-214-835 Winding Diagram
05-214-838 Winding Diagram
05-311-499 Connection Diagram- DC Generator
05-215-216 Armature Coil - Multi. Type HCC10 52-11
05-188-458 Connection Diagram DC Generator
05-411-449 Dynamic Brake MG Set - Outline MG Set
05-411-453 Dynamic Brake MG Set - General Assembly
05-188-458 Dynamic Brake MG Set – Connection Diagram DC Generator
12342-1-E Circulating Oil System Schematic Flow Design
12342-7B Oil Cellar Plan & Sections for MG #2
12342-4C Oil Cellar Plan & Sections for MG #1
12342-8B Oil Cellar Plan & Sections for MG #3
12342-6B General Arrangement of 2500 Gallon Circulating Oil Tank for MG #1
12342-9 General Arrangement of 2500 Gallon Circulating Oil Tank for MG #2
12342-11 General Arrangement of 2500 Gallon Circulating Oil Tan for MG #3
12342-12 Control Wring & Circulating Oil System
K-60711 GRW Rotary Pump
Y-60712 GRW Rotary Pump
D-317 Hilco Hyflow Oil Filter Type "F"
D-3-168-001-4 Outline Dimensions for No.168 Orifice Plates
C-161412 Heat Exchanger Assembly
4356-E1 Float Switch
2188-D225 Tank Flow Switch
3126 & 3161 Magnetic Liquid Level Gauge Gear Type
N0K-746-C200 lb. W.O.G. Iron Body Double Disk Gate Valve
N0K-530 125 lb Iron Body Swing Check Valve
BC-21165NAX Special TMO-1236 Immer. Htr.
ASK-40385 Wiring Diagram for TMO-12XX Immer. Htr.

Note: All the drawings for the elementary and wiring are available upon request.

APPENDIX VI

10CFR851 "Worker Safety & Health Program"

http://www.pppl.gov/eshis/plans/CFR_851_Safety_Health_Prgm.pdf .

APPENDIX VII

Integrated Safety Management Plan

http://www.pppl.gov/eshis/plans/PPPL_ISM.pdf

APPENDIX VIII

PPPL HOISTING and Rigging Procedure, ENG-021

http://www.pppl.gov/eshis/procedures/eng021.pdf

APPENDIX IX

LIFTING DEVICES STANDARDS

PPPL requires conformance with all applicable OSHA and ASME B30 Standards regarding powered industrial truck, Aerial lifts, Fall Protection, and Hoisting and Rigging applications. These shall include but are not limited to:

OSHA 1910 Subpart N
1910.178 - Powered industrial trucks.
1910.179 - Overhead and gantry cranes.
1910.180 - Crawler locomotive and truck cranes.
1910.184 - Slings.

OSHA 1926 Subpart L
1926.453 - Aerial lifts.
1926.454 - Training requirements.

OSHA 1926 Subpart M – Fall Protection

OSHA 1926 Subpart N - Cranes, Derricks, Hoists, Elevators, and Conveyors
1926.550 - Cranes and derricks.
1926.554 - Overhead hoists.

ASME B30 series:

ASME	Standard
B30.1	Jacks
B30.2	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
B30.3	Construction Tower Cranes
B30.4	Portal, Tower, and Pedestal Cranes
B30.5	Mobile and Locomotive Cranes
B30.6	Derricks
B30.7	Base Mounted Drum Hoists
B30.8	Floating Cranes and Floating Derricks
B30.9	Slings
B30.10	Hooks
B30.11	Monorails and Underhung Cranes
B30.12	Handling Loads Suspended From Rotorcraft
B30.13	Storage/Retrieval (S/R) Machines and Associated Equipment
B30.14	Side Boom Tractors
B30.15	Mobile Hydraulic Cranes Note: B30.15-1973 has been withdrawn. The revision of 830.15 is included in the latest edition of B30.5
B30.16	Overhead Hoists (Underhung)
B30.17	Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
B30.18	Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)
B30.19	Cableways
B30.20	Below-the-Hook Lifting Devices
B30.21	Manually Lever Operated Hoists

B30.22 Articulating Boom Cranes
B30.23 Personnel Lifting Systems
B30.24 Container Cranes
B30.25 Scrap and Material Handlers
B30.26 Rigging Hardware
B30.27 Material Placement Systems
B30.28 Balance-Lifting Units

In addition to these standards, PPPL requires the following:

1) Procedural Steps - Prior to award, proposing H&R subcontractor shall provide details of all H&R procedures, including references to Lift Plans (see next paragraph) and proposed equipment to be used.

2) Lift Plans - Prior to any lift or rigging, H&R subcontractor shall provide a lift Plan for review and approval, including:
   a. Plan view of lift with dimensions, including any nearby structures or power lines. Ensure that all crane locations are identified with dimensions to loads (picking and setting).
   b. Section View rigging sketch with dimensions and listing all slings and hardware and their capacities. Load angle factors should be calculated and provided on sketch.
   c. Crane load charts as applicable

   NOTE: A generic lift plan may be provided but rigging shall be sized for the largest worst-case load.

3) Lift Execution
   a. Any item to be lifted that weighs more than 80% of the capacity of the crane shall be witnessed by PPPL. Load cells may be required. For planning purposes, proper notice shall be given.
   b. All items to be lifted shall have known weights. If a weight estimate needs to be made, the estimate calculation shall be provided in writing.
   b. Lifts of items valued at more than $200,000 shall be witnessed by the PPPL Lift Manager.
   c. Hard Hats, safety shoes and gloves shall be used during lifts.
   d. ASME Hand Signals with clear lines of sight shall be used at all times.
   e. Slings shall be in good condition. Kinked or bent wire rope shall not be used. Highly worn and frayed synthetic slings are also unacceptable and shall not be used.
   f. Any unusual conditions shall be brought to the PPPL contract representative's attention immediately.
   g. Anyone has stop work authority.

4) Mobile Crane Certifications - Prior to any lift or rigging, H&R subcontractor shall provide Crane Certifications for review, including:
   a. Evidence of recent periodic inspection.

b. For subcontracted mobile cranes, current annual inspection and current monthly wire rope and brake inspection (sample form attached).

NOTE: Mobile cranes shall be free from leaks and all safety limits must be operational.

5) Mobile Crane Operator Qualifications - Prior to any crane lift, H&R subcontractor shall provide the designated crane operators qualifications including:
   a. NJ Crane Operators License.
   b. NCCCO (CCO) qualification is desirable
   c. Narrative of recent and frequent experience with proposed crane.

6) Crane Operator and Rigger Certifications - Prior to any lift or rigging, H&R subcontractor shall provide Crane Operator and/or Rigger Certifications for review. A narrative of experience, with number of years of similar lifts, is acceptable.

7) PPPL requires strict adherence to OSHA. Standard 29 CFR 1910.179(n)(3)(vi) for overhead and gantry cranes states that "The employer shall require that the operator avoid carrying loads over people." OSHA Standard 29 CFR 1926.550(a)(19) for mobile cranes states "All employees shall be kept clear of loads about to be lifted and of suspended loads."

8) Forklift Operator Experience – Prior to any forklift operation, H&R subcontractor shall provide evidence of forklift operator experience. A narrative of operator experience, with number of years, is acceptable.

9) A 125% proof load test certificate shall be provided for all subcontractor provided below the hook lifting devices and lift beams.

APPENDIX X

CRANE INSPECTION FORM

MONTHLY HOOK, RUNNING ROPE, & BRAKE INSPECTION

Equipment: _____

Owner: _____

Inspector (Print): _____

Rope Identification: _____

Result of inspection (Circle):

Rope: PASS FAIL _____

Hook: PASS FAIL _____

Brakes: PASS FAIL N/A _____

Comments (if any): _____

_____

_____

Signature: _____ Date: _____

1910.180(g)
"Rope inspection." –

1910.180(g)(1)
"Running ropes." A thorough inspection of all ropes in use shall be made at least once a month and a certification record which includes the date of inspection, the signature of the person who performed the inspection and an identifier for the ropes shall be prepared and kept on file where readily available. All inspections shall be performed by an appointed or authorized

person. Any deterioration, resulting in appreciable loss of original strength shall be carefully observed and determination made as to whether further use of the rope would constitute a safety hazard. Some of the conditions that could result in an appreciable loss of strength are the following:

..1910.180(g)(1)(i)
1910.180(g)(1)(i)
Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

1910.180(g)(1)(ii)
A number of broken outside wires and the degree of distribution of concentration of such broken wires.

1910.180(g)(1)(iii)
Worn outside wires.

1910.180(g)(1)(iv)
Corroded or broken wires at end connections.

1910.180(g)(1)(v)
Corroded, cracked, bent, worn, or improperly applied end connections.

1910.180(g)(1)(vi)
Severe kinking, crushing, cutting, or unstranding.

1910.180(g)(2)
"Other ropes."

1910.180(g)(2)(i)
Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care shall be taken to inspect ropes at these locations.

1910.180(d)(6)
"Inspection records." Certification records which include the date of inspection, the signature of the person who performed the inspection and the serial number, or other identifier, of the crane which was inspected shall be made monthly on critical items in use such as brakes, crane hooks, and ropes. This certification record shall be kept readily available.