Case No. 10-2364-EL-REN
Auglaize Hydroelectric Plant Unit 4
Staff Interrogatories – Initial Set

Question 1: If the capacity of unit 4 has increased due to repairs and retrofits that were done since January 1, 1998, please submit the following:

- Documentation showing the capacity of unit 4 pre-January 1, 1998
- Documentation proving the capacity increase of unit 4 due to repairs and retrofits since January 1, 1998

Answer 1:

- Included in the documentation are the specifications that stator and rotor of Unit 4 were rewound to specifically the requirement in section 5.10 for an increase in capacity.
- Included the page from the 1995 feasibility study Bryan Municipal Utilities had done with the test results of Unit 4.
- Included is a 2002 SCADA report of the highest 24 hour Unit 4 average output prior to the generator rewind, retrofits and modifications under normal operating conditions.
- Included is a 2010 SCADA report of the highest 24 hour Unit 4 average after the generator rewind, retrofits and modifications under normal operating conditions.
- Additional documentation including operational log books and hand recorded meter readings are available if required

650 KVA, 2,400 VOLT HYDRO GENERATOR REWIND

1. LOCATION AND SCOPE OF WORK

1.1. This project is located in the City of Defiance, Ohio and is owned by the City of Bryan, Ohio. The work site (delivery location) is 14268 Power Dam Road, Defiance, Ohio 43512.

1.2. The approved repair/rewinding shop shall be responsible for the handling of the generator, rewinding and refurbishment of the generator as specified herein. The generator shall be rewound to be reinstalled at the Auglaize Hydroelectric Dam in Defiance, Ohio.

1.3. The repair shop shall be responsible for all trucking, offloading, repair, painting, testing and shipment back to the Owner. The Owner shall load and unload the generator at the Owner's facility. The rewinding shop shall pay for all trucking to and from the facility as well as loading and unloading at the repair shop.

2. OWNER AND ENGINEER AND MANUFACTURER (CONTRACTOR)

2.1. Owner
Bryan Municipal Utilities
841 E. Edgerton Street
Bryan, OH 43506
419-633-6100
419-633-6105 Fax
Attn: Mr. Stephen A. Casebere,
Matt Killion, Superintendent of Auglaize Hydroelectric Power Dam

2.2. Engineer
MK Power Solutions, Inc.
708 Winterberry Drive
Findlay, Ohio 45840
419-422-1224
419-422-5876 Fax
Attn: Michael E. Kiser, P.E.
mk@mkpowersolutions.com

2.3. Contractor: The term Repair Shop and Manufacturer shall be interchangeable for this specification. The Repair Shop or Manufacturer shall be the person, firm, or corporation with whom the Owner executes an agreement.

3. TIME FOR COMPLETION AND SHIPMENT

3.1. Equipment supplied according to this Contract shall be completely manufactured, tested and delivered to the Defiance, Ohio address listed above no later than August 10, 2010.

4. PAYMENT SCHEDULE

4.1. The following payment schedule shall be followed for this Contract and shall take precedence over terms and conditions which are outlined in the General Conditions of the Contract:
4.1.1. 10% of Contract Amount may be billed 30 days from the date of execution of the Contract.
4.1.2. 80% of Contract Amount may be billed upon shipment of equipment to job site.
4.1.3. 10% of Contract Amount shall be retained until equipment is either placed into service or Engineer is satisfied that the breakers are ready to be energized.

5. WINDING DESIGN REQUIREMENT

5.1. Winding design shall conform to the National Electrical Manufacturers Association (NEMA) Standard MG1.

5.2. Insulation design shall conform to Underwriters Laboratory standard UL 1446 (Systems of Insulating Materials – General).

5.3. The repair shop shall be responsible for preparing the winding design, selection of material and the rewinding of the generator. All necessary winding and slot measurements are the responsibility of the Manufacturer. The repair shop shall perform a site visit as required to obtain these measurements for preparation of this bid.

5.4. Windings for the stator and rotor shall utilize the highest quality materials and insulation class available for rewinding generators of this vintage and type.

5.5. Coil conductor shall be Copper Magnet Wire which meets all NEMA MW wire standards.

5.6. Each coil shall be machine wound to dimensions as determined by the winding shop from field measurements.

5.6.1. Each coil shall receive a pretape, while in loop form, consisting of one (1) layer of .004 x ¾" treated glass tape ½ lapped on diamonds; space lapped in slot sections.

5.6.2. Each could shall be dipped in Class H varnish and baked.

5.7. Each coil shall be machine spread to proper coil configuration as determined by the repair shop.

5.8. Each coil shall be internally hot and cold pressed to size.

5.9. The winding design shall be submitted to the Engineer for review and approval prior to proceeding with the winding construction. In the submittal, the Manufacturer shall provide details regarding:

5.9.1. Turn Insulation Material and Class of Insulation
5.9.2. Phase Insulation Material to be Utilized (Sheet Material)
5.9.3. Ground Insulation Material to Be Utilized (Slot Liners)
5.9.4. Description of Wedge Materials and Method of Installation
5.9.5. Lacing and Tape Material and Method of Installation
5.9.6. Varnish Material to be Utilized, and Method of Application

5.10. Winding capacity shall be increased to provide additional unit capacity by increasing copper volume and/or increasing winding insulation capabilities. The goal of the rewind is to provide a minimum of 110% of nameplate capacity (i.e. 715 kVA).

6. COIL INSULATION

6.1. Winding insulation shall be Class H type insulation.

6.2. Each winding lead shall be sleeved with one (1) 7000 Volt acrylic-glass tubing.

6.3. Each coil shall receive one (1) layer of ground tape consisting of .006 x ¾" "resin-filled mica tape (Samica #4902) ½ lapped all around.

6.4. Each coil shall receive a 5 ¼ turn .006 "resin filled" mica cell wrapper (Samica #4902) lap started on side.

6.5. Each lead shall be sealed with RTV Silicon Sealant.

6.6. Each coil shall receive one (1) layer .006 x ¾" "Armor-Seal" tape (Electrolock #248264200) ½ lapped all around and baked.

7. ROTOR COIL REQUIREMENTS

7.1. Pole Piece Insulation shall be rated 300 Volts/MIL and Class H 200 C around Pole Body.

7.2. Pole collars and rivets shall be insulated with Haysite 755 Class F (155 C) Material

7.3. Coils shall be wet wound with Epoxy (U-300) Class H (200 C)

8. INSPECTION, DISASSEMBLY AND REASSEMBLY OF THE GENERATOR

8.1. The repair shop shall be responsible for the offloading and visual inspection of the generator.

8.2. The repair shop shall perform any electrical testing necessary for the Manufacturer to comply with the warranty requirements of these specifications. These tests shall be the responsibility of the Manufacturer and provided to the Owner at the time of testing.

8.3. Upon completion of inspection and testing, the generator shall be completely disassembled, cleaned and dried by oven baking.

8.4. All bearing surfaces shall be polished and protected during repair of the unit. The Owner shall mark these surface limits with wax or marker.

8.5. The stator housing, rotor webbing and all non-electrical surfaces shall be painted according to the Owner's color preferences.

8.6. New copper windings shall be installed for the stator and the rotor windings. Upon installation of the new windings, the Owner shall be notified for a site inspection of the windings, lacing, wedges and construction techniques.

8.7. The entire stator and rotor shall be dipped in varnish to seal the windings and all construction materials such as lacing, blocks, wedges, etc.

9. ACCESSORIES

9.1. Nine (9) 100 Ohm Platinum RTDs shall be installed in the stator windings of the generator. The stator RTDs shall be installed and properly insulated prior to varnish treatment.

9.2. Three (3) 600:5 current transformers, ANSI class C200 CTs shall be installed on the stator windings.

9.3. Junction box: A NEMA 1 junction box shall be installed on the unit. The junction box shall contain current shorting terminal blocks and control terminals required for the RTDs. The location of the junction box shall be submitted for approval by the engineer.

9.4. The nine (9) RTDs and three (3) CTs shall be wired to the terminal blocks. CT wiring shall be a minimum of #10 AWG wiring.

10. TESTING AND TRANSPORT:

The repair shop shall perform all NETA or otherwise recommended tests on the newly rewound generator rotor and stator. At a minimum, the following tests shall be performed.

10.1. Stator:
- 10.1.1. DC Resistance (Meggar)
- 10.1.2. Polarization Index
- 10.1.3. DC High Potential Test

10.2. Rotor
- 10.2.1. DC Resistance (Meggar)
- 10.2.2. Polarization Index
- 10.2.3. AC Resistance
- 10.2.4. DC High Potential Test
- 10.2.5. Pole Drop Test for Establishment of Baseline Pole Drops

AUGLAIZE HYDROELECTRIC PROJECT

Feasibility Study

Submitted to

Bryan Municipal Light & Water Utilities

November, 1995

SAWVEL AND ASSOCIATES
Consultants and Engineers
100 E. Main Cross • Suite 300, 45840
P.O. Box 1306
Findlay, Ohio 45839-1306
Tel 419-422-4812
Fax 419-423-5076

Table 4

Power-Gate Test Results

Unit No.	Maximum Tested Normalized Output (kW)	Generator Limited Output (kW)
1	753	650
2	0	0
3	0	0
4	716	650
5	676	650
TOTAL	2,145	1,950

Detailed spreadsheets and graphical results are attached as Tables 5, 6, 7 and Figure 2.

Note that the maximum output, tested briefly and mathematically normalized to a common head, exceeds generator nameplate (a value which the operator usually uses to limit output). In Unit 1 (the only unit with gate position indication), the generator nameplate rating, even at unity power factor, is reached at a wicket gate opening of only 80 percent. This is because the generator's original design rating was based on the original turbine design output at a rated head of about 18 feet, whereas the turbine-generator is now operating at a head of about 21 feet. This also explains why the turbines of Units 1, 4 and 5 do not cavitate or vibrate and why their power curve continues to rise steeply even at maximum generator output. These turbines are underutilized, and the units and plant are generator limited.

An attempt was made to develop rough unit efficiencies by correlating to flow at the USGS gage just downstream of the plant. However, gage flow readings yielded unit efficiencies ranging from 50 to over 100 percent and were not useful. When new, these turbines would typically have full gate efficiencies in the order of 80 to 85 percent. In their present condition and off-design application, these could be expected to be derated to 75 to 80 percent. Individual unit flow measurement would be required to determine actual efficiency.

Unit #4 Daily Production From SCADA April 2002

OnPeak/OffPeak Report — *Unit #4 Monthly Output* — Page 1
From: 4/1/2002 12:00:00 AM To: 4/30/2002 11:45:00 PM Interval: 1 Minute Average
Adding Items: 2019 On Peak Total = 242016.38
Subtracting Items: Off Peak Total = 141994.39
Accumulated Total: 384010.77 Load Factor (%): 71.81 Percent good: 99.37

Date	On Peak Total	Off Peak Total	Daily Total	Day
4/1/2002	4265.20	2503.78	6768.98	Mon
4/2/2002	6802.07	3422.58	10224.65	Tue
4/3/2002	7915.39	4689.77	12605.16	Wed
4/4/2002	9039.86	5081.53	14121.39	Thu
4/5/2002	9791.27	5843.85	15635.12	Fri
4/6/2002	10029.99	5984.88	16014.87	Sat
4/7/2002	9998.61	5379.40	15378.02	Sun
4/8/2002	9644.70	6140.27	15784.97	Mon
4/9/2002	8693.25	5904.30	14597.55	Tue
4/10/2002	7507.57	4045.47	11553.03	Wed
4/11/2002	8306.89	5002.17	13309.06	Thu
4/12/2002	9489.42	5433.94	14923.36	Fri
4/13/2002	9298.81	5431.54	14730.36	Sat
4/14/2002	8227.25	4981.39	13208.64	Sun
4/15/2002	8132.93	4919.39	13052.32	Mon
4/16/2002	8576.97	5041.75	13618.72	Tue
4/17/2002	10384.19	5739.43	16123.62	Wed
4/18/2002	10449.38	6191.38	16640.75	Thu
4/19/2002	9581.11	5909.19	15490.30	Fri
4/20/2002	8730.05	5434.26	14164.32	Sat
4/21/2002	1836.84	3703.67	5540.51	Sun
4/22/2002	0.00	0.00	0.00	Mon
4/23/2002	9390.52	1229.60	10620.11	Tue
4/24/2002	3995.88	5185.91	9181.80	Wed
4/25/2002	8132.67	4164.91	12297.58	Thu
4/26/2002	7187.04	3939.50	11126.53	Fri
4/27/2002	9096.53	5489.14	14585.67	Sat
4/28/2002	9202.97	5477.23	14680.20	Sun
4/29/2002	9111.55	4220.32	13331.87	Mon
4/30/2002	5935.18	4055.78	9990.96	Tue

Maximum one day output for 2002 occurred on 4/28
Recorded 16,680.2 kWh for 24 hour period
16,680.20 kWh / 24 hr = 695 kW average output

Unit #4 Daily Production From SCADA March 2010

TIME	Positive mWh (cumulative)	kWh (daily)
03/01/2010 00:00	871.40	0
03/02/2010 00:00	871.40	0
03/03/2010 00:00	880.31	8910
03/04/2010 00:00	898.81	18500
03/05/2010 00:00	916.15	17340
03/06/2010 00:00	933.12	16970
03/07/2010 00:00	950.31	17190
03/08/2010 00:00	967.30	16990
03/09/2010 00:00	984.05	16750
03/10/2010 00:00	1003.16	19110
03/11/2010 00:00	1020.80	17640
03/12/2010 00:00	1038.36	17560
03/13/2010 00:00	1055.99	17630
03/14/2010 00:00	1072.97	16980
03/15/2010 00:00	1087.62	14650
03/16/2010 00:00	1103.02	15400
03/17/2010 00:00	1119.06	16040
03/18/2010 00:00	1137.48	18420
03/19/2010 00:00	1156.19	18710
03/20/2010 00:00	1162.12	5930
03/21/2010 00:00	1162.12	0
03/22/2010 00:00	1162.12	0
03/23/2010 00:00	1162.12	0
03/24/2010 00:00	1173.82	11700
03/25/2010 00:00	1190.71	16890
03/26/2010 00:00	1195.25	4540
03/27/2010 00:00	1208.87	13620
03/28/2010 00:00	1228.29	19420
03/29/2010 00:00	1247.00	18710
03/30/2010 00:00	1260.45	13450
03/31/2010 00:00	1274.83	14380

Maximum one day output for 2010 occurred on 3/28
Recorded 19,420 kWh for 24 hour period
19,420 kWh / 24 hr = 809 kW average output

Summary: Response to interrogatories from Mathew Killion electronically filed by Mr. Craig K. Preston on behalf of CITY OF BRYAN