PART 1 – GENERAL

1.1 SCOPE

A. This section covers furnishing design, drawings, materials, and accessories as specified herein for paralleling switchgear to be used to parallel the new hydro power plant on Chuniisax Creek for the community of Atka (See Drawing G-1). The Work included herein shall consist of, but not be limited to, designing, fabricating, providing, and factory testing complete automatic paralleling switchgear and controls, as specified herein. The hydro turbine and generator equipment has been provided by others and is located in the existing powerhouse. The penstock, dam, transmission line, and communication lines remain to be constructed.

B. A hydro generation facility is currently in the process of being constructed on Chuniisax Creek. The switchgear provided shall be designed to operate the hydro in concert with the existing Atka diesel generation facility switchgear via a suitable communications link. Required PLC programming to incorporate the existing diesel generation into the hydro generation is required by the supplier of the hydro generation facility switchgear.

C. The paralleling switchgear shall be capable of unattended operation or manual operation. Automatic start/stop and demand control shall be accomplished through a Programmable Logic Controller (PLC). The generator shall have a stationary mounted, manually operated molded case circuit breaker with solid-state trip modules for equipment and conductor protection. The generator breaker shall have a electrically operated contactor to perform the normal on line/off line paralleling functions of the generator load controlled by the PLC.

D. The programming shall be capable of performing the required functions for this project as described herein. The control program and associated operators manual shall be provided along with all access codes necessary to allow independent use of the program. The program shall be written in a readily obtainable language like Modbus or equivalent. The Contractor shall specify the programming language in the proposal. The program and associated hardware shall be designed with flexibility to allow modifications to meet unforeseen future requirements. The system and programming must be designed to allow the control and distribution of excess hydro energy to supply heating loads depending on the status of the diesel generators.

E. The specifications and drawings are complementary. What is shown on one is binding whether or not it is shown or specified in the other. Failure to check both the drawings and specifications will not be grounds for a change order if additional equipment or material is required to be provided by the Contractor after the Engineer reviews the drawings, or deficiencies are identified during testing, either in the Factory or the field.

F. The Contractor shall provide a complete and operational system as specified herein. Certain components are identified in these specifications to be provided by the Contractor. However, the components identified shall not be construed to be the

complete list of components required for the successful operation of the systems as specified. The Contractor shall provide all components and design required for the complete and successful operation of the system, conforming to all of the requirements specified herein, whether the components are identified or not. The Contractor shall ensure that all devices are installed and operate within their intended purposes.

G. Drawings SG1, SG2, SG3 and SG4 are included at the end of this specification and shall be used in the design of the switchgear.

H. The Contractor shall fully test the switchgear separately from the generating equipment.

I. The switchgear shall be designed and constructed in accordance with these specifications and drawings included as part of these specifications.

J. The switchgear package shall provide for remote monitoring and control of the system. All necessary wiring and communications equipment shall be supplied to allow for remote monitoring and communications.

1.2 QUALITY ASSURANCE

A. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. Equipment shall not have been in service any time prior to delivery, except as required by testing.

B. The switchgear shall also be assembled and tested in strict accordance with the applicable standards of NEC, ANSI, IEEE and NEMA, for metal enclosed low voltage switchgear.

C. Solid-state circuitry shall meet or exceed the Transient Over voltage Withstand Test per NEMA ICS1-109 and the Surge Withstand Capability Test (SWC) per IEEE Standard 472 (ANSI C37.90A).

1.3 CONTRACTOR QUALIFICATIONS

A. The Contractor shall provide verification of a minimum of ten years experience in the design, fabrication, and construction of automatic load demand paralleling switchgear and successful working installations in small rural Alaska hydro systems. Relevant experience includes, but is not limited to, electronic governors, load banks, PLC systems, programs, system protection and waste energy recovery. Experience is required with large motor operations and controls and their integration into power systems. The Contractor will be selected based on the technical ability to provide the specification requirements; the ability to manufacture or have manufactured all of the required equipment; the demonstrated ability to commission similar systems in Rural Alaska; an example of a control operations manual meeting the requirements of this specification; experience in training local rural operators; the ability to provide and integrate waste energy recovery systems with the hydro.

B. The supplier of the hydro generation switchgear shall demonstrate its ability to supply a system that works in concert with the hydro and diesel power plants to utilize excess (waste) energy from the hydro plant for heating purposes. Although not a part of this project, the excess energy system may be requested of the Contractor under a potential future contract. The system shall be provided control the usage of energy in excess of the priority loads and allow for its distribution throughout the community of Atka in order to displace the use of heating fuel. The system and associated equipment must be able to economically provide energy to both small and large heating loads and utilize the existing power grid for both energy distribution and control of the system. The system must provide for the hydro generation switchgear work with the system to dispatch the heating loads as required utilizing a frequency controlled device or the equivalent. The Contractor must provide information demonstrating that the system has been used successfully elsewhere.

C. A list of successful installations with installation dates, description of installation, and a contact for each installation shall be submitted with the bid. Bids submitted without this information will be considered non-responsive.

1.4 DRAWINGS

A. The panel manufacturer shall provide internal wiring and connection diagrams for each section of the switchgear, a one-line diagram, and three-line diagrams. Provide a bill of material for all devices in the switchgear. The one-line diagram shall show all breakers, protective devices, and control devices and shall use standard ANSI symbols. The drawings shall show all connections between terminal blocks, auxiliary switch contacts, control devices, instrumentation, protection devices, etc. Drawings shall also show all details of enclosure construction.

B. Provide drawings of all AC and DC wiring. Provide a communication connection diagram showing all buses and expansion block cables.

C. Provide schematics of all controls. Schematics shall be in ladder diagram format and shall show all control devices and external terminal block numbers.

D. Provide drawings showing terminal block layouts with interconnecting wiring indicated. The drawings shall show the physical layout of the terminal blocks with their appropriate designations.

E. Provide drawings that show nameplate engraving. Provide drawings of control switches showing all terminals with numbers, including terminals not used. Identify the use of the terminals.

F. All shipping splits shall be clearly identified. Wiring harnesses shall be provided between shipping splits for any control wiring required to connect between units. Drawings shall clearly indicate the wiring harness and connections. Terminal blocks shall be provided between the shipping splits for ease in wiring in the field.

G. Additionally, the panel manufacturer shall provide pertinent information for each PLC. Pertinent information shall include a complete ladder diagram showing all

address numbers, rung reference numbers, all preset register values, extensive commentaries describing the purpose of each rung, complete tables or schedules listing all utilized I/O addresses, internal relay addresses, and timer, counter, and register addresses and values, and the date of the latest revision.

1.5 OPERATIONS AND MAINTENANCE MANUALS

A. Provide operation and maintenance (O&M) manuals for all equipment provided under this contract.

B. Include the following information in the O&M manuals:

1. Installation, assembly, and commissioning instructions.
2. Equipment function, normal operating characteristics, and limiting conditions.
3. Assembly, installation, alignment, adjustment, and checking instructions.
4. Operating instructions for start-up, routine and normal operation, regulation and control, shutdown, and emergency conditions.
5. Guide to "troubleshooting."
6. Parts lists, with vendor name and telephone number, and predicted life of parts subject to wear.
7. Complete as-built drawings showing all details of construction.

C. The O&M manuals shall include a table of contents and tabs shall separate each section.

1.6 FIELD SERVICES

The Contractor shall provide a day-rate for onsite installation, field-testing and startup of the switchgear and associated equipment. This contract shall include any offsite time required for troubleshooting and programming revisions required for startup.

PART 2 - PRODUCTS

2.1 GENERAL.

All equipment and material shall be new. Equipment furnished and installed under this section shall be fabricated and assembled in full conformity with the drawings, specifications, engineering data, instructions, and applicable standards. All equipment shall be of "utility grade" or higher quality.

2.3 SWITCHGEAR ENCLOSURE

The following paragraphs describe general fabrication requirements for the switchgear enclosure.

A. Provide a freestanding enclosure that is factory built, wired, and tested by the switchgear manufacturer. Hinged front-opening doors shall provide required access to all components. Control wire shall have termination identification of each wire for ease of tracing. Terminal blocks shall be provided for control wires that run between generator set and control panel. Nameplates shall be provided to identify each device or function.

B. The switchgear shall be front access only. All devices, including current transformers, shall be easily replaceable from the front. All switchgear sections shall be dead front type NEMA 1A construction. Switch gear enclosure types shall be suitable for a damp environment as anticipated in a hydro generation powerhouse.

2.4 CONTROL POWER

A. Control power for the switchgear shall derived from the 12 VDC batteries to allow for a "Black Start" capability.

B. All meters, remote monitoring, and other components requiring auxiliary power to operate shall operate from this control power source, unless otherwise specified.

C. Each section shall be provided with a means to isolate control power within the section from the other sections.

D. Each major device or meter shall be individually protected by circuit breakers. Clearly mark each circuit breaker for the intended service.

2.5 PAINTING

A. Steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces that will be inaccessible after assembly shall be protected for the life of the equipment. Surfaces shall be cleaned and prepared in the shop. All mill scale, oxides, and other coatings shall be removed.

B. All metal enclosure parts shall be phosphatized to ensure that the metal is properly degreased and cleaned.

C. Exposed surfaces shall be finished smooth, thoroughly cleaned and filled as necessary to provide a smooth uniform base for painting and painted with one or more coats of

primer and two or more finish coats of alkyd resin machinery enamel or lacquer as required to produce a smooth hard durable finish. The color of the finish coats shall be ANSI 61 light gray.

D. Provide a premium painting system throughout the painting process from initial cleaning to final assembly to assure a superior paint finish. All coatings shall be applied using an electro static paint system.

E. Interior shall be ANSI 61 gray, except that the back pans in compartments with control wiring shall be white.

F. All parts of the switchgear enclosure shall be painted. No enclosures or interior surfaces may be left unpainted, no exceptions.

2.6 WIRING

A. All control wiring shall be minimum 14-gauge, 41-strand type SIS wire or equivalent. Current transformer wiring shall be 12-gauge SIS type wire. All wires for control wiring shall have non-insulated spade type lugs, except where compression terminals are used. All current transformer leads shall be provided with non-insulated ring-type lugs. All lugs shall be tin-plated copper.

B. Only one wire shall be inserted in a lug. Lugs shall be installed with a ratcheting type crimping tool. All wires shall be tagged with wire markers at both ends.

C. All wiring shall terminate on terminal blocks or devices. No more than two wires shall be connected to a termination point. Terminal blocks for control wiring shall be 20 amp, 600 volt. All terminal blocks and exposed relays located in the controls compartment shall be provided with a plastic safety cover. Terminal blocks for 12 VDC and 24 VDC shall be separated from terminal blocks for 120 VAC.

D. Current transformer leads shall be wired to shorting type terminal blocks. For multi-ratio current transformers, all leads shall be brought to the terminal block. Shorting pins shall be provided and storage locations for the shorting pins shall be provided.

E. Terminal blocks shall be clearly labeled and shall match the designation shown on the Contractor's drawings. A separate terminal strip shall be provided for interconnection with each generator.

F. Each end of each wire shall be identified per the marking and numbering shown on the wiring drawings with heat shrink labels. Each conductor shall have the terminal or device the conductor is terminated to at both ends positively identified at both ends of the conductor.

G. Wiring shall be installed neatly in bundles and wireways. Adhesive backed tyrap bases shall not be used to support bundles. All wiring bases shall be securely attached with metal screws.

2.7 SWITCHGEAR DEVICES.

A. Nameplates. All nameplates shall be black with white core type. Nameplates shall have beveled edges and shall be secured with a minimum of two mounting screws. Nameplates shall be provided for each device on the front of the switchgear and inside the switchgear. Inside the switchgear compartments, all relays, control switches, lights, etc. to which control or instrument transformer wiring connects, shall be marked by nameplates, with designations corresponding to the same device designations used on the wiring drawings and approved by the Engineer. Nameplates inside the switchgear may be attached using adhesive epoxy.

B. Overall nameplate. Provide an overall nameplate that provides the following information:

1. Contractor's name and address.
2. Contractor's type designation (optional).
3. Contractor's shop order number.
4. Rated maximum voltage.
5. Rated frequency.
6. Rated bus ampacity.

C. Protective Devices. The Contractor shall include all necessary protective devices. Protective relays and other devices shall include, but not be limited to, those indicated on drawing SG3 unless otherwise approved by the Engineer.

2.8 MONITORING AND CONTROL SPECIFICATIONS

The generator switchgear shall provide controls to automatically connect and parallel the hydro generator to the Atka power grid. The Contractor shall review all drawings and information provided and shall incorporate all turbine operation safety functions into switchgear controls.

The Contractor shall design and build the controls to:

1. Control frequency for clocks as required by the State of Alaska.
2. Control the rate of water flow change, with the gate positioning, to prevent water hammer or excessive low penstock pressure. The restriction values shall be programmable into the controls.
3. Optimize the hydro-diesel system to maximize fuel savings.
4. Control the hydro to minimize energy losses at the load bank.
5. Facilitate the startup and operation of large motor loads (i.e. Atka Pride's refrigeration compressor motor loads). The Contractor is to make reccomendations for operational changes or equipment modifications to facilitate servicing of such loads.
6. Integrate the hydro with the diesel plant as described in this specification. Contractor is responsible for obtaining the necessary information from Alaska Energy Authority or others to allow for proper operation, connection, and interfacing with the diesel plant. As

required, any changes to the diesel plant necessary for integration shall be recommend by the Contractor.

7. Control the amount of water stored in the reservoir to optimize power output. An applied algorithm will be provided by the Contractor for approval by the Engineer to meet this requirement.
8. To automatically operate the fish bypass valve. The valve shall be at full open when turbine is off and water is not flowing over the spillway. The power minimum set point shall be variable to assure fish bypass water is in the stream below the turbine. The fish bypass valve actuator shall be supplied by others. An applied algorithm will be provided by the Contractor for approval by the Engineer to meet this requirement.
9. To maximize plant output in order to minimize use of fuel by the diesel generators. Controls shall be programmable, to utilize rates of rise and fall of reservoir water levels and demand schedules to turn on and off the excess energy load modules (waste energy system) and call for diesel generation to assure optimum water levels in the reservoir. An applied algorithm will be provided by the Contractor for approval by the Engineer to meet this requirement.

2.9 HYDROGENERATION FUNCTION MONITORING

A. Provide remote monitoring and control based on the following sensors and switches:

a. Water level:
   Reservoir
   Load governor, low water
b. Pressures:
   Penstock, powerhouse
   Load governor, pressure differential for filter change
c. Temperatures:
   Generator RTD's and bearings
   Water, penstock
   Building, inside
   Outside
   Load governor, water out
d. Electrical
   kW, kWh, VAR's
   kWh, cumulative
   KWh, load dump
   Voltage, each generator phase
   Amperage, each generator phase
   Frequency
   Battery voltage
e. Mechanical
   Generator rpm
   Valve, fish by-pass. open, closed, remote position indicator. 4-20 mA analog control.

Valve, intake. open, closed, remote position indicator. 4-20 mA analog control. Equip with safety lockout.

f. Alarms
   Intrusion
   Fire
   Generator temperatures
   Bearing temperatures
   Building temperature
   Standby battery alarm
   Trip indication
   Load governor, low water
   Load governor, filter change

g. Displays
   Panel and computer in hydro powerhouse
   Remote display and control interface
   Video monitoring, two cameras at powerhouse, two at intake.

2.10 MASTER/DISTRIBUTION SECTION.

The master/distribution section of the switchgear shall be equipped with a digital power monitor for the main bus and power monitors for the station service. The load demand system shall be controlled by a programmable logic controller, with operator interface unit, providing operator access to the demand system and shall display the demand system operating status. System shall include a main disconnect switch to shutoff switchgear and generator power equipped with mechanical lockout to allow servicing of equipment.

2.11 REMOTE ACCESS OF EQUIPMENT

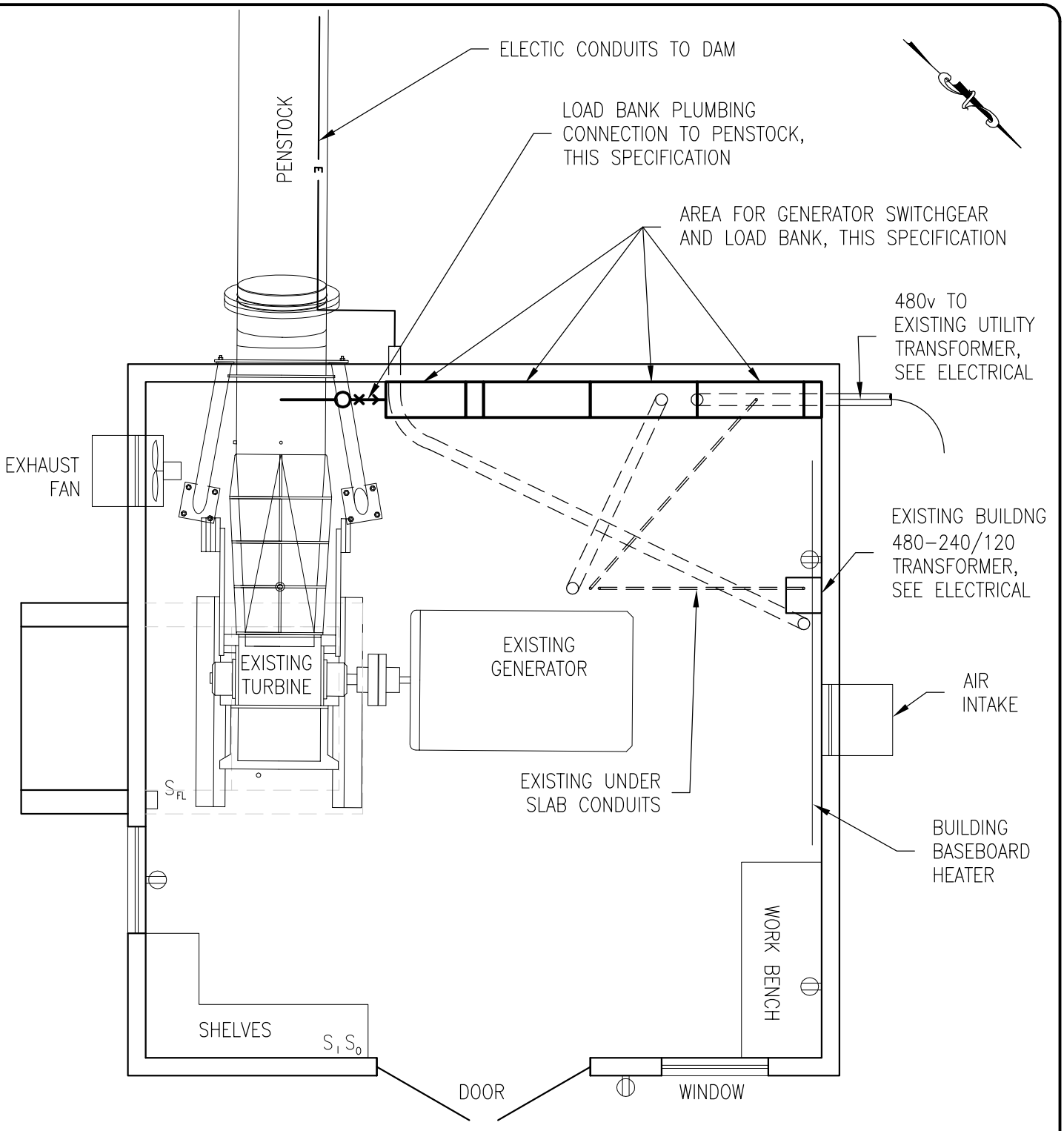
A. The PLC shall be provided with a modem, which shall allow the PLC to be accessed through a dial-up phone line. Modem access shall allow a remote operator to modify and/or view all operational screens and all logic in both the primary and backup PLC.

B. Install an outlet for connection of a remote computer through the RS-485 Ethernet connection, PLC phone modem connection, and a 120 VAC receptacle. The outlet shall be QPIC.

C. The hydro PLC shall communicate with the diesel plant PLC facility via the Ethernet switch.

D. A remote display and control interface shall be provided that is accessible via the internet.

END OF SECTION



DATE: 4/16/10
DESIGNED: EA
DRAWN: MD
CHECKED:
SCALE: NTS
FILE: AtkaSG

DRAWING
HYDROPLANT FLOOR PLAN

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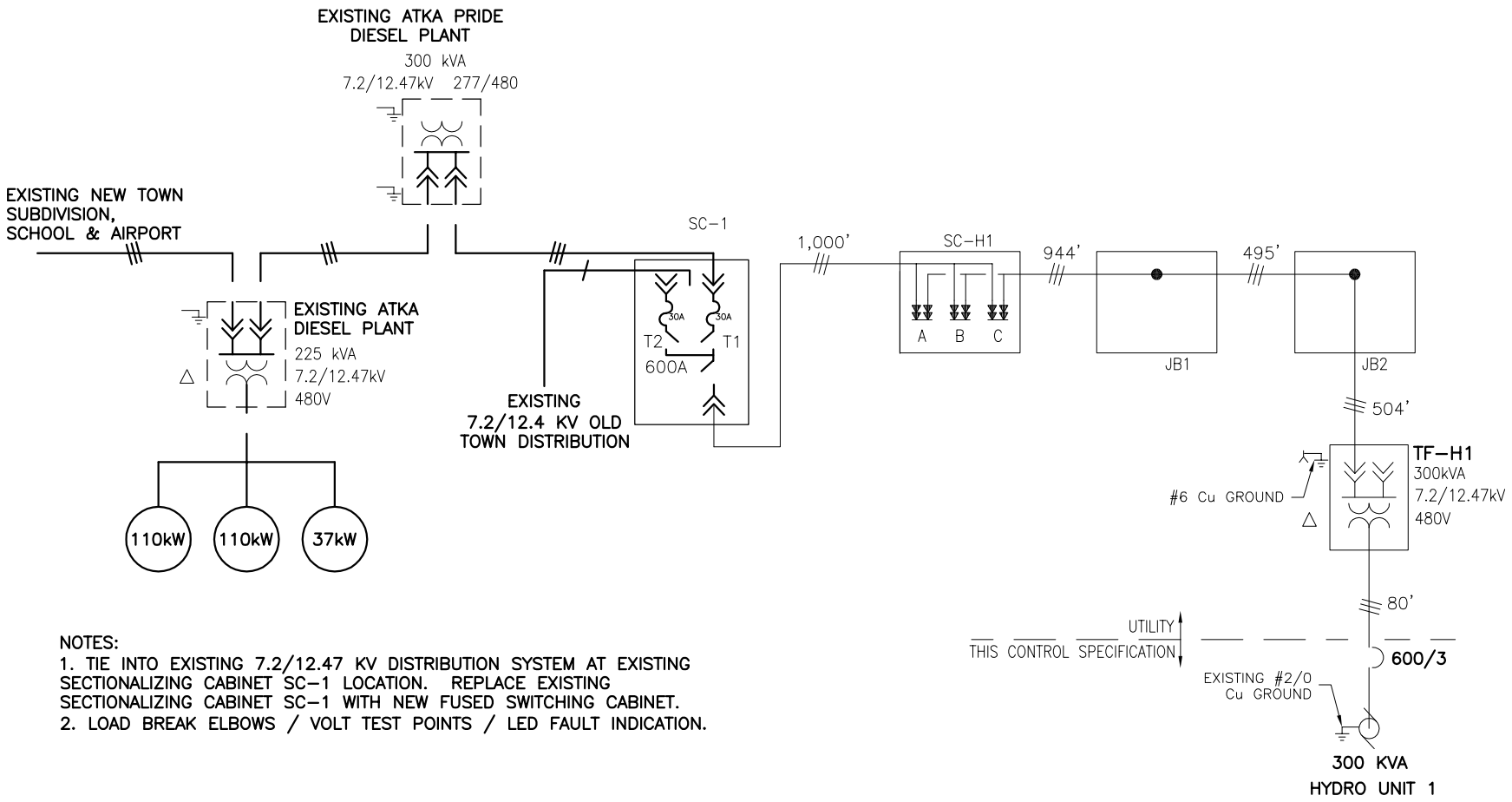
PROJECT
CHUNIISAX CREEK HYDROELECTRIC PLANT
SWITCHGEAR SPECIFICATIONS
ATKA, AK

SHEET
SG1
OF 4



NOTES:
1. TIE INTO EXISTING 7.2/12.47 KV DISTRIBUTION SYSTEM AT EXISTING SECTIONALIZING CABINET SC-1 LOCATION. REPLACE EXISTING SECTIONALIZING CABINET SC-1 WITH NEW FUSED SWITCHING CABINET.
2. LOAD BREAK ELBOWS / VOLT TEST POINTS / LED FAULT INDICATION.

DATE: 4/16/10
DESIGNED: EA
DRAWN: MD
CHECKED:
SCALE: NTS
FILE: AtkaSG

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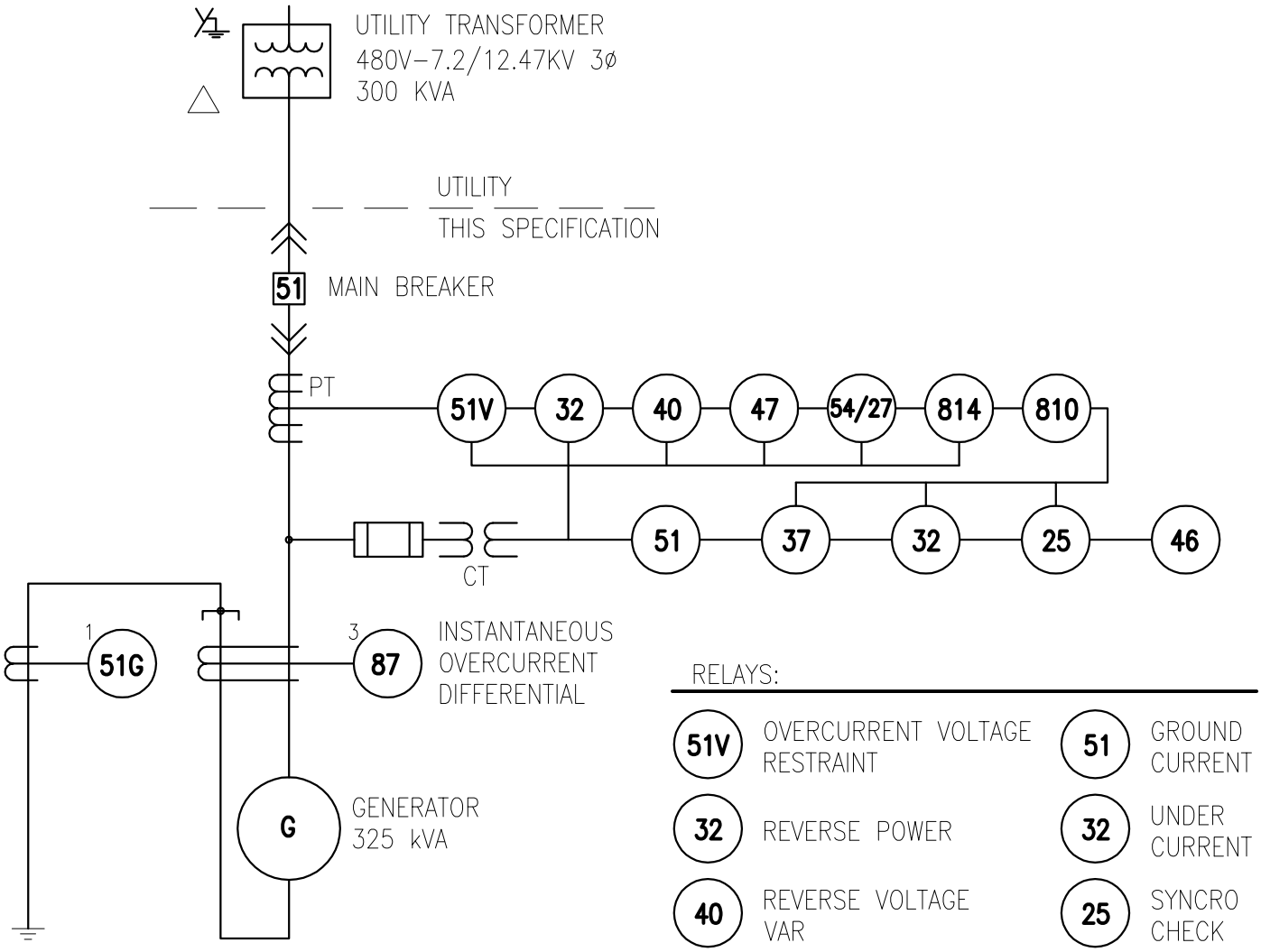
DRAWING
ELECTRIC SYSTEM 1-LINE DIAGRAM

PROJECT
CHUNIISAX CREEK HYDROELECTRIC PLANT
SWITCHGEAR SPECIFICATIONS
ATKA, AK

SHEET
SG2
OF 4



RELAYS:

51V	OVERCURRENT VOLTAGE RESTRAINT	51	GROUND CURRENT
32	REVERSE POWER	32	UNDER CURRENT
40	REVERSE VOLTAGE VAR	25	SYNCRO CHECK
54/27	OVER & UNDER VOLTAGE	46	PHASE BALANCE
814	UNDER FREQUENCY		
810	OVER FREQUENCY		

DATE: 4/16/10
DESIGNED: EA
DRAWN: MD
CHECKED:
SCALE: NTS
FILE: AtkaSG

DRAWING
HYDROPLANT PROTECTIVE RELAYS

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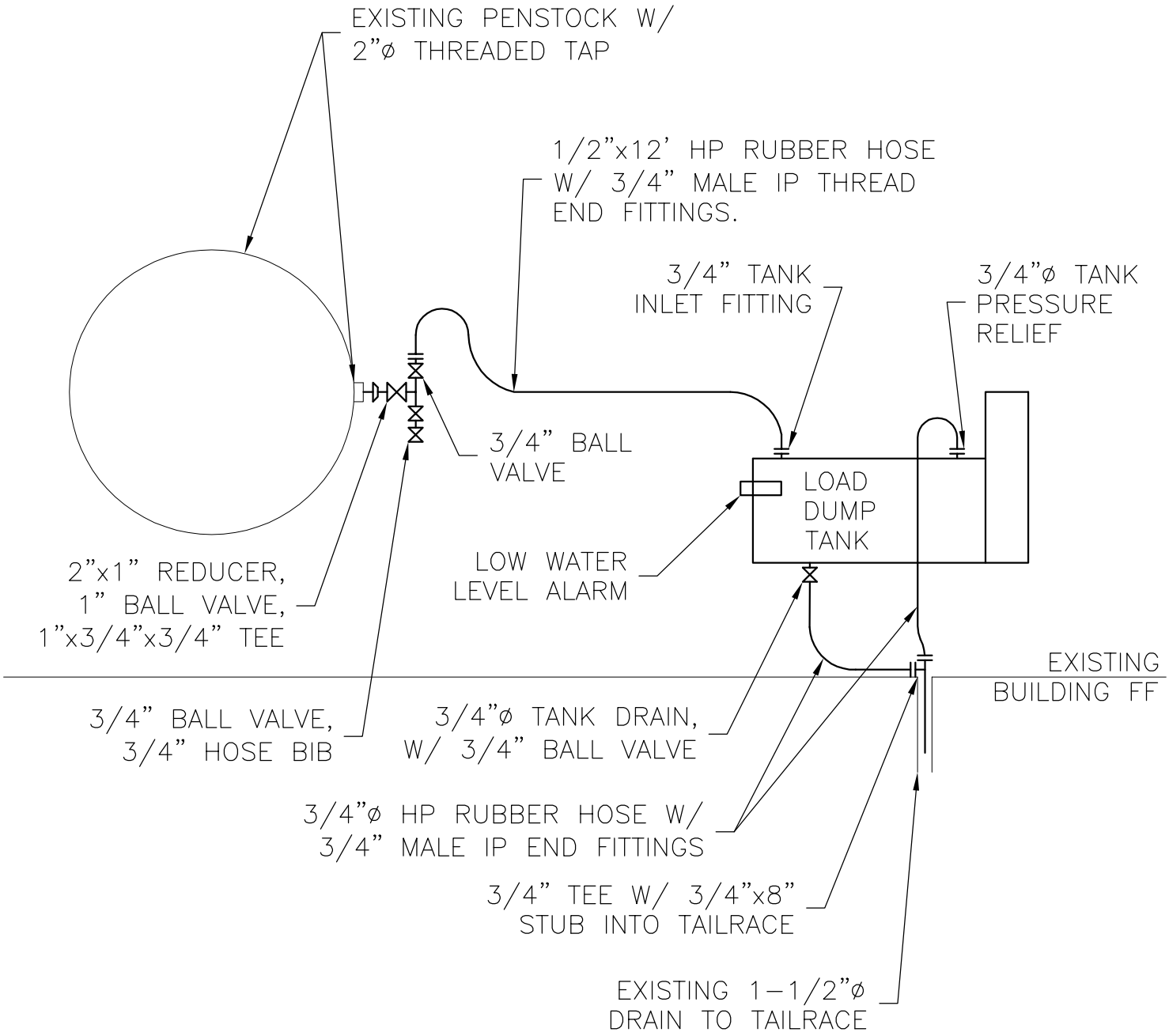
PROJECT
CHUNIISAX CREEK HYDROELECTRIC PLANT
SWITCHGEAR SPECIFICATIONS
ATKA, AK

SHEET
SG3
OF 4

NOTES:

1. ALL PIPING 1"ø AND SMALLER TO BE SWEATED TYPE K COPPER TUBING.
2. ALL BALL VALVES TO BE FULL BORE FULL BALL BRASS OR EQUAL.
3. ALL HIGH PRESSURE RUBBER HOSE TO BE RATED FOR 150 PSI. END FITTINGS TO BE SAME PRESSURE RATING.
4. HOSE BIBS TO BE THREADED.
5. PROVIDE SUPPORTS FOR TANK, PIPE AND TUBING.



DATE: 4/16/10
DESIGNED: EA
DRAWN: MD
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SCALE: NTS
FILE: AtkaSG

DRAWING
HYDROPLANT LOAD DUMP PLUMBING

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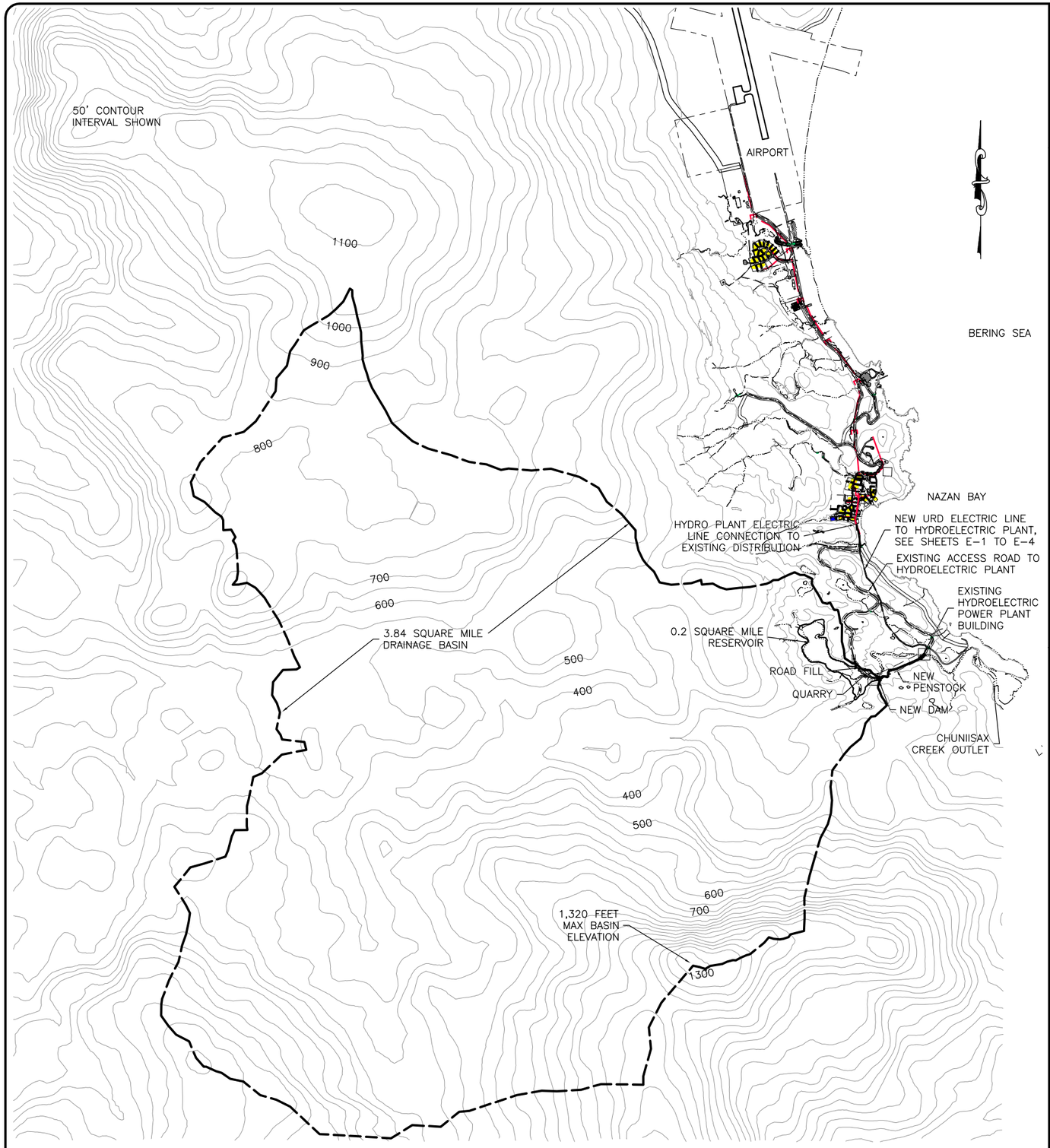
PROJECT
CHUNIISAX CREEK HYDROELECTRIC PLANT
SWITCHGEAR SPECIFICATIONS
ATKA, AK

SHEET
SG4
OF 4

CHUNIISAX CREEK HYDROELECTRIC PROJECT
ATKA, ALASKA

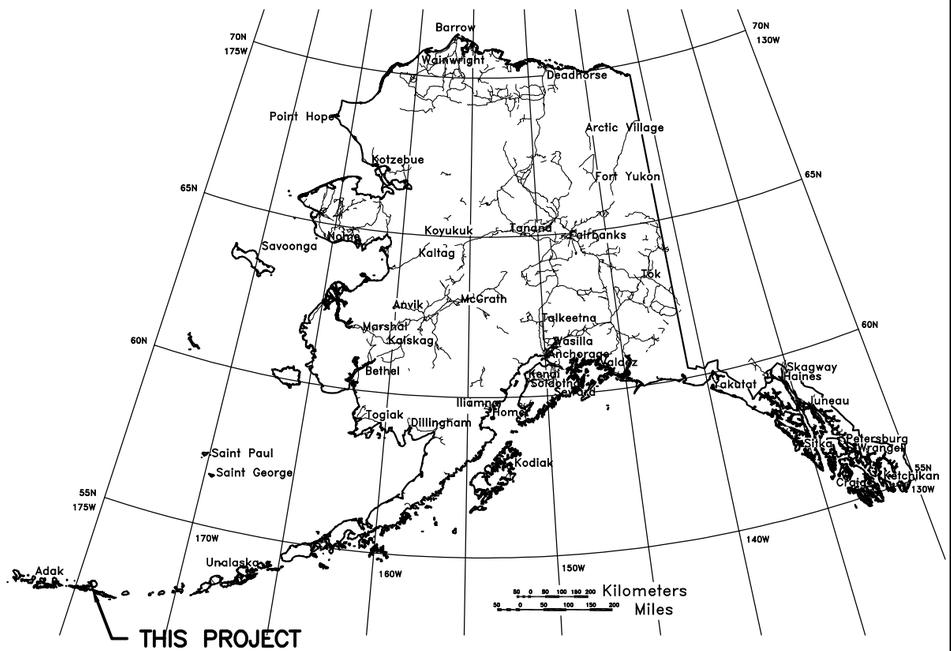
EDA PROJECT AWARD
07-01-06108



1 ELECTRIC SITE PLAN
SCALE: 1 INCH = 1,000 FEET

SHEET INDEX:

PLANT DATA		
INSTALLED CAPACITY:	284	KW
TURBINE TYPE:	CROSS-FLOW	
TURBINE DESIGN FLOW:	37.1	CFS
DAM SPILLWAY ELEVATION:	169.00	FEET
POWERHOUSE FINISH FLOOR ELEVATION:	51.3	FEET
TAILRACE ELEVATION:	41.7	FEET
AVERAGE OPERATING WATER ELEV.:	169.15	FEET
TOTAL PLANT GROSS HEAD:	117.85	FEET
FULL FLOW HEAD LOSS:	4.29	FEET
PENSTOCK DIAMETER:	30	INCHES
PENSTOCK LENGTH:	952	FEET
DRAINAGE BASIN:	3.85	SQ. MILES
ANNUAL AVERAGE PRECIPITATION:	61.5	INCHES
ACTIVE STORAGE:	37.5	ACRE FT
AVERAGE STREAMFLOW:	29.46	CFS
100 YEAR FLOOD FLOW:	654	CFS
500 YEAR FLOOD FLOW:	839	CFS



2 --
SCALE: 1" = 100 KILOMETERS

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STATE OF ALASKA
49th
MICHAEL D. DAHL
No. CE-8480
4-15-10
REGISTERED PROFESSIONAL ENGINEER

NO.	DATE	REVISIONS

Drawing: CHUNIISAX CREEK HYDROELECTRIC PROJECT
SITE PLAN, AND NOTES

Project: CHUNIISAX CREEK HYDROELECTRIC PROJECT
EDA AWARD # 07-01-06108
Atka, Alaska

DATE: 4/15/10
DESIGNED: MDD
DRAWN: MD
CHECKED: EA
SCALE: AS NOTED
FILE: _MAINDAM

Sheet
G-1
OF 4