



To: Matt Hutson  
SGM Inc

Project: Creede Hydro feasibility study

Date: 9/14/2020

**Project Overview:**

To assess the feasibility of installation and operation of a small hydro electric turbine on Willow Creek for the purpose of offsetting the town of Creedes' electrical energy consumption. The system would be interconnected to the local utility (SLVREC) as an aggregated meter offset. The study includes a target goal of 95% renewable energy offset. In order to reach that target goal an additional smaller hydro electric resource on East Willow Creek as well as a supplemental 93KWDC photo-voltaic system have been identified.

## Executive Summary

This feasibility study report was prepared for the Town of Creede, Creede CO to evaluate the potential for the installation and operation of a micro hydroelectric system to generate electricity to offset the towns' electrical energy consumption.

### Site Description

The site is located on Willow Creek located within the town limits of Creede. The intake structure would be located on the North end of town with the penstock routed along the East edge of the improved flume that runs North to South through the town. The hydro turbine and associated structure to house it would be located at the South end of town where the improved flume ends.

### Site History

The improved flume was completed in 2018 by Mays Construction Specialties, Inc and will serve as the route for the hydro turbine penstock. This report was prepared using data from "A pre-feasibility study" prepared by the University of Colorado at Boulder dated 4/7/2004 and flow data from the Willow Creek Gauge station from 1952-1981.

### Basis for hydroelectric generation

The installation and operation of a micro hydroelectric system is based on the location and availability of existing water resources within the town limits. Due to the constrained nature of the topography surrounding the town of Creede, alternative options such as wind turbines and or photo-voltaic systems are not as efficient as hydroelectric. The data analyzed shows a potential for a renewable energy resource to accomplish the Towns goal of operating on renewable energy.

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## **1.0 Introduction**

Colorado Energy System has prepared this feasibility study for the Town of Creede located in Creede, CO. This feasibility study report was prepared for the Town of Creede to evaluate the potential for the installation and operation of a micro hydroelectric system to generate electricity to offset the towns' electrical energy consumption. The site is located within the town of Creede and includes hydroelectric resources on both Willow Creek and East Willow Creek. This report includes historical data on the town's electrical usage for both 2018 and 2019. Initial design and location are included under the "System design details" section of this report.

### **1.1 Purpose of the feasibility study**

The report focuses on the Willow Creek resource and it further identifies two additional resources to offset the towns' electrical energy usage. The systems would be interconnected to the local utility (SLVREC) as an aggregated meter offset. The study includes a target goal of 95% renewable energy offset. In order to reach that target goal an additional smaller hydroelectric resource on East Willow Creek as well as a supplemental 93KWDC photo-voltaic system have been identified.

### **1.2 Site location and description**

The site is located on Willow Creek located within the town limits of Creede. The intake structure would be located on the North end of town on the east side of Willow Creek with the penstock routed along the East edge of the improved flume that runs North to South through the town. The hydro turbine and associated structure would be located at the South end of town where the improved flume ends. The location of the turbine and turbine house were determined based on efficient use of the head pressure for turbine production as well as proximity to existing SVLREC power transmission lines. Both intake and turbine locations are identified in the site plan included in section 4.1. The site plan also includes the two additional renewable energy resource locations. The photo-voltaic locations are preliminary potential locations only. The 5KW hydroelectric turbine system is based on an existing 8" unused water intake that runs from East Willow Creek to a standpipe located near the proposed intake on Willow Creek.

### **1.3 Site history**

The Town of Creede is located in Mineral County Colorado. According to historical documentation hydroelectric power was generated from a system that has since been de-commissioned on East Willow Creek. The details on that system are no longer available but its existence does demonstrate historical utilization of Willow Creek water

for electrical generation. The University of Colorado at Boulder completed a pre-feasibility study for hydroelectric resources in 2004 which was utilized in this feasibility study report.

The improved flume was completed in 2018 by Mays Construction Specialties, Inc and will serve as the route for the hydro turbine penstock.

## **2.0 Previous Investigations**

In the preparation of this report two previous investigation resources were utilized. The flow data from the Willow Creek Gauge Station averaged from 1952 to 1981 and the 2004 University of Colorado at Boulder “A Pre-Feasibility Study for a Micro-Hydropower Facility on Willow Creek at Creede, Colorado” both support the proposed implantation of micro-hydro electric resource on Willow Creek.

### **2.1 2004 University of Colorado at Boulder “A Pre-Feasibility Study for a Micro-Hydropower Facility on Willow Creek at Creede, Colorado”**

The study prepared by the University of Colorado at Boulder was conducted based on a visit to the area in May of 1995. The study supports the use and development of a hydroelectric resource on Willow Creek. However, the report highlights the highly variable flow nature of Willow Creek based on seasonal flows and states that hydro turbine sizes could range from 24KW to 75KW.

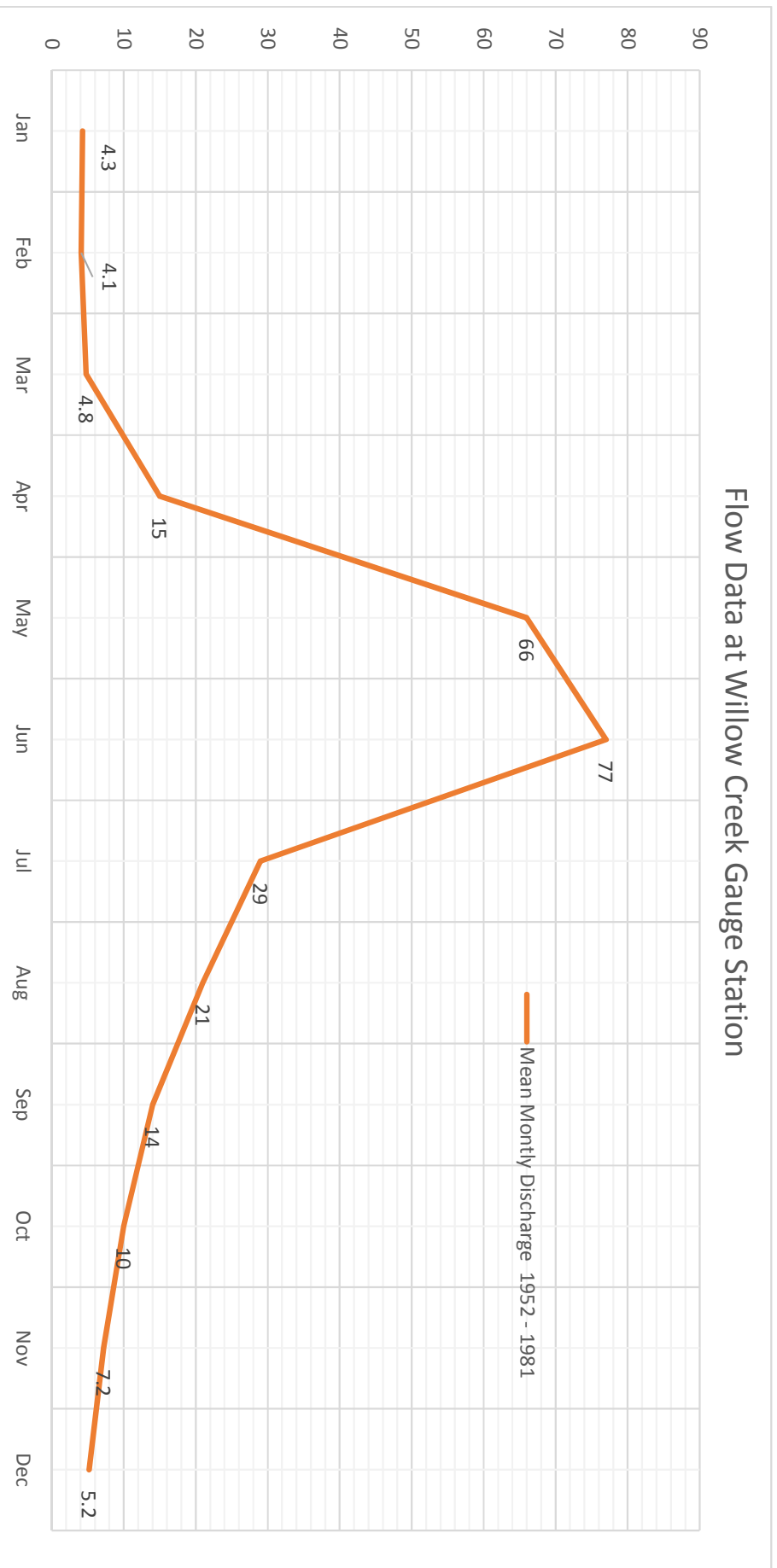
## **3.0 Basis for Micro-hydroelectric System**

The installation and operation of a micro hydroelectric system is based on the location and availability of existing water resources within the town limits. Due to the constrained nature of the topography surrounding the town of Creede, alternative options such as wind turbines and or photo-voltaic systems are not as efficient as hydroelectric. The data analyzed shows a potential for a renewable energy resource to accomplish the Towns goal of operating on renewable energy.

### **3.1 Hydroelectric Power resource assessment**

The hydroelectric power resource available from Willow Creek was assessed utilizing the historical data from the Willow Creek Gauge station collected from 1952 to 1981. The data from the Gauge shows highly variable streams flows throughout the year. This data is also confirmed in the University of Colorado Pre-Feasibility study. Based on the minimum mean stream flows of 4.1CFS the year-round minimum flow resources were utilized in the assessment of the available resource. The head height of 110’ was derived from the survey data provided by SGM, Inc assuming an intake structure located prior to where Willow Creek enters the improved flume and a hydroelectric turbine inlet approximately 5 feet above the bottom of the flume just prior to the end of the improved flume. These conditions allow for a design criteria of 4.0CFS at 100’ of net head.

### Flow Data at Willow Creek Gauge Station



## 4.0 System design details

The system design was performed with the consideration for maximizing the year-round aggregated production of the hydroelectric system. By following the existing improved flume, we eliminate the need for additional excavation and or re-routing of the flume. The distance following the flume from the spillway to the South end of the improved flume is approximately 4,800 linear feet based on survey information provided by SGM, Inc. Based on the 4CFS of minimum mean stream flow, 100' of net head, and 4,800 linear feet of penstock the design basis was a 23KW hydroelectric turbine. The penstock would be constructed of Polymer pipe with a nominal dimension of 16" to deliver the 4CFS from the intake to the hydroelectric turbine.

### 4.1 Site Plan

The site plan identifies the location of the 23KW hydroelectric turbine intake structure, the location of the 23KW hydroelectric turbine house, the 5KW hydroelectric turbine house, and the two potential photo-voltaic sites. This study focuses on the 23KW hydroelectric turbine. The other potential renewable energy resources are included for reference only. See Page 17 for site plan.

### 4.2 Hydroelectric plant description

The hydroelectric plant will consist of the following components:

**Turbine:** Canyon horizontal dual nozzle Pelton turbine with the following features.

- CF8M stainless steel turbine runner, ground, polished and balanced
- 316 stainless steel needle nozzles and nozzle beaks with hydraulic actuators and 4-20 mA position transducers.
- Jet deflector system with hydraulic actuator and full open limit switch
- Fabricated steel housing, nozzle bodies and inlet manifold, powder coated
- Turbine main shaft labyrinth seals with centrifugal slinger and splash plate
- Pillow block mounted double row spherical roller bearings, grease lubricated
- Design flow 4 cfs at 100 feet net head
- Turbine shaft speed 525 RPM
- Structural steel turbine, geardrive and generator mounting frames
- Hydraulic power unit to support actuation of nozzles and jet deflectors
- Flexible direct drive coupling sets
- Toothed wheel and speed pickup bracket

**Generator:**

- US Motors or equivalent 29 kW, 1800 RPM, 480 VAC, 60 hertz, 3 ph., induction generator, complete with shaft and bearings designed for direct coupling between the turbine and geardrive shaft. To include winding thermostats, vibration switch and space heaters.

Gear Drive:

- Flender single stage gear drive for coupling between the turbine and the generator. Nominal gear ratio 3.4:1.0.

**Switchgear and Controls:**

- Custom US manufactured low voltage switchgear and controls panels to parallel the generator with the local electrical grid. Protection by utility grade multifunction relay, PLC based automatic control, hard wired manual control, digital multimeter and operator interface screen.

**System Drawing:**

See Pages 18 and 19 for system drawing.

**System Electrical One-Line:**

See Page 20 for electrical one line drawing.

**4.3 Intake Structure**

The proposed intake structure will be located upstream of the spillway on the East side of Willow Creek. (See Page 21 for intake design drawing. See Page 22 for site photo)

## **5.0 Electrical Consumption and Offset**

The electrical consumption and offset report was generated utilizing the Town of Creedes' electrical utility bills from 2018 and 2019. The 2019 numbers were used to generate the 95% target off set for the town based on LED lighting upgrades performed on town owned buildings leading to a lower overall energy consumption for the year. The 5KW hydroelectric site as well as the potential photo-voltaic system were included in the offset report for reference.

**5.1 Electrical Consumption and offset report**

See Page 24 for Electrical Consumption and offset report.

## **6.0 Utility Interconnect Process**

San Luis Valley Rural Electric Cooperative (SLVREC) requires that any customer owned generator that is connected to their utility grid have a Net Meter Distributed Generation (DG) facility application in place. The utility requires that the facility is located on land that is either owned, leased, operated or otherwise controlled by the SVLREC member. This study focused on a meter aggregation approach so that the town may utilize the energy produced by the hydroelectric turbine to offset the use of multiple locations throughout the town without directly connecting to each location. When the electricity supplied by the member owned DG facility exceeds the energy supplied by SLVREC during a billing period, the excess electricity will be banked for usage in the next billing period. Annually in April, excess electricity banked to the members account will be purchased by SLVREC at the Cooperative's average cost of wholesale energy of the previous calendar year.

**6.1 San Luis Valley Rural Electric Cooperative, Inc. Net Meter Distributed Generation Guideline**



## **GENERAL**

In order to receive electric service from San Luis Valley Rural Electric Cooperative, Inc. (SLVREC), a customer must join or become a member (Member) of San Luis Valley Rural Electric Cooperative, Inc. For more information about SLVREC's membership application process, please contact Customer Service at 719-852-3538.

SLVREC permits Members to install a Net Metered Distributed Generation (DG) facility, provided the Member's DG facility does not adversely affect the operation and reliability of SLVREC's electric system. The Member must conduct their own analysis to determine the economic benefit of DG operation.

A DG facility connected in any way to SLVREC's system must receive approval from SLVREC prior to installation.

This guideline is not a complete description or listing of all laws, ordinances, rules and regulations, nor is this guideline intended to be an installation or safety manual. The Member requesting to interconnect a DG facility to SLVREC's system must follow all provisions of this guideline, SLVREC's *Rules and Regulations and Tariffs for Electric Service*, SLVREC's *Line Extension Policy*, the current *IEEE 1547 Standard Guide for Distributed Generation Interconnection* (a copy is on file at SLVREC for inspection along with information so the Member may obtain his/her own copy), other applicable IEEE standards, applicable ANSI standards, including ANSI C84.1 Range A and any other applicable governmental and regulatory laws, rules, ordinances or requirements. All legal, technical, financial requirements in the following sections of this Manual must be met prior to interconnection of the DG facility to SLVREC's system.

A DG facility may serve any load behind the meter at the location of the DG facility but is not permitted to serve multiple meters, multiple consuming facilities or multiple Members with a single DG facility or under a single DG application without prior approval by SLVREC.

## **I. DETERMINE THE SIZE OF THE DISTRIBUTED GENERATION FACILITY**

### 1) DG Project Size

#### a) Residential

A residential DG facility connected in a Net Metering installation may be designed with a capacity up to the greater of:

- i) Up to 10 kilowatts; or
- ii) 120% of the previous 12 months electric energy consumption, up to 25 kW; or
- iii) 120% of the estimated 12 month electric energy consumption, up to 25 kW if the DG facility will be installed on a new service. The design capacity factor for a DG facility shall be 20%.

#### b) Commercial

Up to 25 kilowatts

### 2) Qualifying Facilities

- a) Qualifying Facilities (QF) are defined by the Public Utility Regulatory Policies Act of 1978 (PURPA). Refer to CFR Title 26, Volume 4, Sec. 292.204. SLVREC allows only QF facilities to be net metered. A QF must have as its primary energy source biomass, waste, wind, solar, geothermal resources or any combination. See PURPA for a full description.

- b) SLVREC will provide interconnection for a DG facility to Members, subject to the provisions of this guideline and all other applicable rules and regulations.

## **II. MEMBER'S INITIAL REQUIREMENTS**

- 1) Members must meet all SLVREC's membership and service requirements in addition to the requirements in the guideline.
- 2) In advance of constructing a DG facility, the Member must complete the San Luis Valley Rural Electric Cooperative Net Meter/Distributed Generation Application and include a \$100.00 application fee.
- 3) A separate application form must be submitted for each facility.

## **III. COOPERATIVE REVIEW PROCESS**

- 1) SLVREC will review the application and accompanying documents, plans, specifications, and other information provided and will return a letter authorizing the construction the proposed facility to the Member within 60 days.
- 2) Technical review will be consistent with guidelines established by the most recent *IEEE Standard 1547 Guide for Distributed Generation Interconnection*. The Member may be required by SLVREC to provide proof that their DG facility have been tested and certified by applicable IEEE guidelines.
- 3) If corrections or changes to the plans, specifications and other information are made by the Member, the 60 day period may be reinitialized when such changes or corrections are provided to SLVREC. In addition, any changes to the site or project requiring new analysis by SLVREC will require a new Net Meter/Distributed Generation Application.
- 4) The Member acknowledges and agrees that any review or acceptance of such plans, specifications and other information by SLVREC shall not impose any liability on SLVREC and does not guarantee the adequacy of the Member's equipment or DG facility. SLVREC disclaims any expertise or special knowledge relating to the design or performance of generating installations and does not warrant the efficiency, cost-effectiveness, safety, durability, or reliability of such DG installations.
- 5) In the event it is necessary at the time of initial interconnection or at some future time for SLVREC to modify electric delivery systems in order to serve the Member's DG facilities, or because the quality of the power provided by the Member's DG adversely affects SLVREC's delivery system, the Member will be responsible to pay SLVREC for all costs of modifications required for the interconnection of the Member's DG facilities.

## **IV. SALES TO AND PURCHASES FROM A DG FACILITY**

- 1) Power produced by the DG facility will be compensated by netting the kilowatt-hours generated against the kilowatt-hours consumed.
- 2) When the kilowatt-hours produced by the DG facility are less than the kilowatt-hours consumed by the Member, SLVREC shall bill the Member according to SLVREC's applicable retail rate schedule including the net electricity supplied to the Member during the billing period.

- 3) When the monthly production of electricity supplied by the DG facility is greater than or equal to the kilowatt-hours consumed by the Member, the monthly charge and/or minimum bill of the retail rate schedule shall be billed by SLVREC. Any excess electricity produced will be credited to the Member's account and carried forward. On April 30 of each year, any excess accrued electricity produced by the DG facility during the preceding 12 months will be calculated by SLVREC. The excess electricity produced by the DG facility will be purchased from the Member at the SLVREC's average wholesale power cost calculated over the same May 1 through April 30 period.
- 4) SLVREC shall not be required to make any purchases that will cause SLVREC to no longer be in compliance with any applicable contracts or all-power contract requirements with its power supplier(s).

## **V. MEMBER'S RESPONSIBILITY PRIOR TO OPERATION**

- 1) Line Extension and Modifications to Cooperative Facilities
  - a) As a part of the interconnection analysis performed by SLVREC, the Member will be provided with an estimate of any line extension or other cost to be incurred in providing electric delivery service to the Member's DG facility. The Member shall pay, in advance, the full cost of the construction of any transmission, substation, distribution, transformation, metering, protective relaying, or other facilities or equipment which, at the sole discretion of SLVREC is required to serve the DG facility.
  - b) The DG facility shall not energize the San Luis Valley Rural Electric Cooperative power system when the area power system is de-energized.
- 2) Liability Insurance
  - a) The Member must provide proof of general liability insurance in the following amounts:
    - i) \$300,000 for systems with installed capacity of 10kW or less.
    - ii) \$1,000,000 for systems with installed capacity greater than 10kW.
  - b) The amount of the insurance may be increased at the sole discretion of SLVREC if the nature of the project so requires.
  - c) The insurance policy will not be changed or canceled without thirty days written notice to SLVREC.
  - d) Member must provide proof of continued insurance annually.
  - e) SLVREC must be listed as a named insured.
- 3) Initial Interconnection
  - a) After completion of the application and review process and prior to initiation of service, SLVREC will conduct a final inspection of the facilities and interconnection to SLVREC's system.
  - b) SLVREC will install the appropriate meters on the DG facility after the final inspection and upon payment of a \$100.00 meter installation fee.

- c) SLVREC's review process and final inspection is intended as a means to safeguard SLVREC's facilities and personnel.

## VI. OPERATION OF DG FACILITY

### 1) Ownership of Facility

- a) The Member shall own and be solely responsible for all expense, installation, maintenance and operation of all equipment, including all power generating facilities, at and beyond the point of delivery as defined in SLVREC's tariffs.
- b) At its sole discretion, SLVREC may locate cooperative owned metering equipment and transformers past the point of delivery.

### 2) Self-Protection of DG Facilities

- a) The Member will furnish, install, operate and maintain in good order and repair all equipment necessary for the safe operation of DG facilities interconnected with SLVREC's electric system.
- b) The DG facility must have the ability to both establish and maintain synchronism with SLVREC system and to automatically disconnect and isolate the DG facility from SLVREC system when power from the SLVREC electric system is off.
- c) The DG facility will be designed, installed and maintained to be self-protected from normal and abnormal conditions on SLVREC system including, but not limited to, overvoltage, undervoltage, overcurrent, frequency deviation, and faults. Self-protection will be compatible with all applicable SLVREC protection arrangements and operating policies.
- d) Additional protective devices and/or functions may be required by SLVREC when, in the sole judgment of SLVREC, the particular DG facility installation and/or SLVREC system characteristics so warrant.

### 3) Quality of service

- a) The DG facility will generate power at the nominal voltage of SLVREC's system at the delivery point as defined by ANSI C84.1 Range A.
- b) The DG facility will generate power at a frequency within the tolerances as defined by IEEE 1547.
- c) The DG facility shall produce power at a minimum power factor of at least 95%.
- d) The DG facility shall be in accordance with the power quality limits specified in IEEE 519.
- e) The overall quality of the power provided by the DG facility including, but not limited to, the effects of harmonic distortion, voltage regulation, voltage flicker, switching surges and power factor, will be such that SLVREC system is not adversely affected in any manner.

### 4) Disconnection of DG Facility

- a) The DG facility shall include the installation of a visible load break disconnect switch. The switch will be readily accessible to SLVREC personnel and of a type that can be secured in an open position by a SLVREC lock.

- b) SLVREC reserves the right to operate the disconnect switch for the protection of SLVREC system even if it affects the operation of the DG facility. In the event SLVREC opens the disconnect switch:
  - i) SLVREC shall not be responsible for restoring the DG facility to service.
  - ii) SLVREC will make reasonable efforts to notify the Member.
- c) The Member will not bypass the disconnect switch at any time for any reason.
- d) Signage shall be placed by SLVREC at the switch indicating the purpose of the disconnect switch along with names and phone numbers of appropriate SLVREC personnel.
- e) Should SLVREC lose power serving a DG facility for any reason, the DG facility shall not operate unless visibly disconnected from SLVREC system.
- f) SLVREC may, at its sole discretion, prevent the interconnection or disconnect the interconnection of a DG facility due to reasons such as safety concerns, reliability issues, power quality issues, breach of interconnection contract or any other reasonable issue. **Any disconnection may be without prior notice.**

5) Access

- a) Persons authorized by SLVREC will have the right to enter the Member's property for purposes of testing, operating the disconnect switch, reading or testing the metering equipment, maintaining right-of-way or other DG facility equipment and/or Cooperative service requirement. Such entry onto the Member's property may be without notice.
- b) If the Member erects or maintains locked gates or other barriers, the Member will furnish SLVREC with convenient means to circumvent the barrier for full access for the above-mentioned reasons.

6) Metering/Monitoring

- a) SLVREC shall specify, install and own all metering equipment. Each DG facility shall provide for the installation of two meters, one measuring the flow of electricity on the interconnection with the SLVREC electric system and one meter measuring the production of electricity from the DG facility.
- b) The meter shall be read at a time or times of month determined at SLVREC's sole discretion for acquiring metering data. The Member shall provide SLVREC an approved communications link at the Member's cost for this purpose if so requested by SLVREC. The type of communications link and metering equipment measuring purchase of power by SLVREC shall be installed and specified at the sole discretion of SLVREC.
- c) Meter testing shall follow SLVREC's standard policy on metering testing and accuracy.

7) Notice of Change in Installation

- a) The Member will notify SLVREC in writing thirty (30) days in advance of making any change affecting the characteristics, performance, or protection of the DG facility.
- b) If any modification undertaken by the Member will create or has created conditions which may be unsafe or adversely affect SLVREC system, the Member shall immediately correct such conditions or be subject to immediate disconnection from SLVREC system.
- c) Any change in the operating characteristics of the DG facility including, but not limited to, size of generator, total facility capacity, nature of facility, fuel source, site change, hours of operation, or type used, may require a new application process, including, but not limited to, application form, application fee, DG plan and DG plan review by SLVREC.

8) Testing and Record Keeping

- a) The Member will test all aspects of the protection systems up to and including tripping of the generator and interconnection point at start-up and thereafter as required. Testing will verify all protective set points and relay/breaker trip timing and shall include procedures to functionally test all protective elements of the system. SLVREC may witness the testing.
- b) The Member will maintain records of all maintenance activities, which SLVREC may review at reasonable times.

9) Compliance with Laws, Rules and Tariffs

The DG installation owned and installed by the Member shall be installed and operated subject to and in accordance with the terms and conditions set forth in SLVREC's rules, regulations, bylaws, rates and tariffs, as amended from time to time, and, if applicable, approved by SLVREC's board of directors, which are incorporated herein by reference, and in compliance with all applicable federal, state and local laws, regulations, zoning codes, building codes, safety rules, environmental restrictions, ordinances and regulations, including without limitation, and in accordance with industry standard prudent engineering practices. A system that is net metered is not eligible to be under any Time-of-Day rate schedule.

10) Liability for Injury and Damages

- (a) The Member assumes full responsibility for electric energy furnished at and past the point of interconnection and shall indemnify SLVREC and/or its Power Supplier against and hold SLVREC and/or its Power Supplier harmless from all claims for both injuries to persons, including death resulting there from, and damages to property occurring upon the premises owned or operated by Member arising from electric power and energy delivered by SLVREC or in any way arising directly or indirectly from the Member's DG facility.
- (b) SLVREC and/or its Power Supplier shall not be liable for either direct or consequential damages resulting from failures, interruptions, or voltage and waveform fluctuations occasioned by causes reasonably beyond the control of SLVREC and/or its Power Supplier including, but not limited to, acts of God or public enemy, sabotage and/or vandalism, accidents, fire, explosion, labor troubles, strikes, order of any court or judge granted in any bona fide adverse legal proceeding or action, or any order of any commission, tribunal or governmental authority having jurisdiction. ALL PROVISIONS NOTWITHSTANDING, IN NO EVENT SHALL SLVREC BE LIABLE TO THE MEMBER FOR ANY INTEREST, LOSS OF ANTICIPATED REVENUE, EARNINGS, PROFITS, OR INCREASED EXPENSE OF OPERATIONS, LOSS BY REASON OF SHUTDOWN OR NON-OPERATION OF MEMBER'S PREMISES OR FACILITIES FOR ANY INDIRECT, INCIDENTAL, OR CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES ARISING OUT OF OR

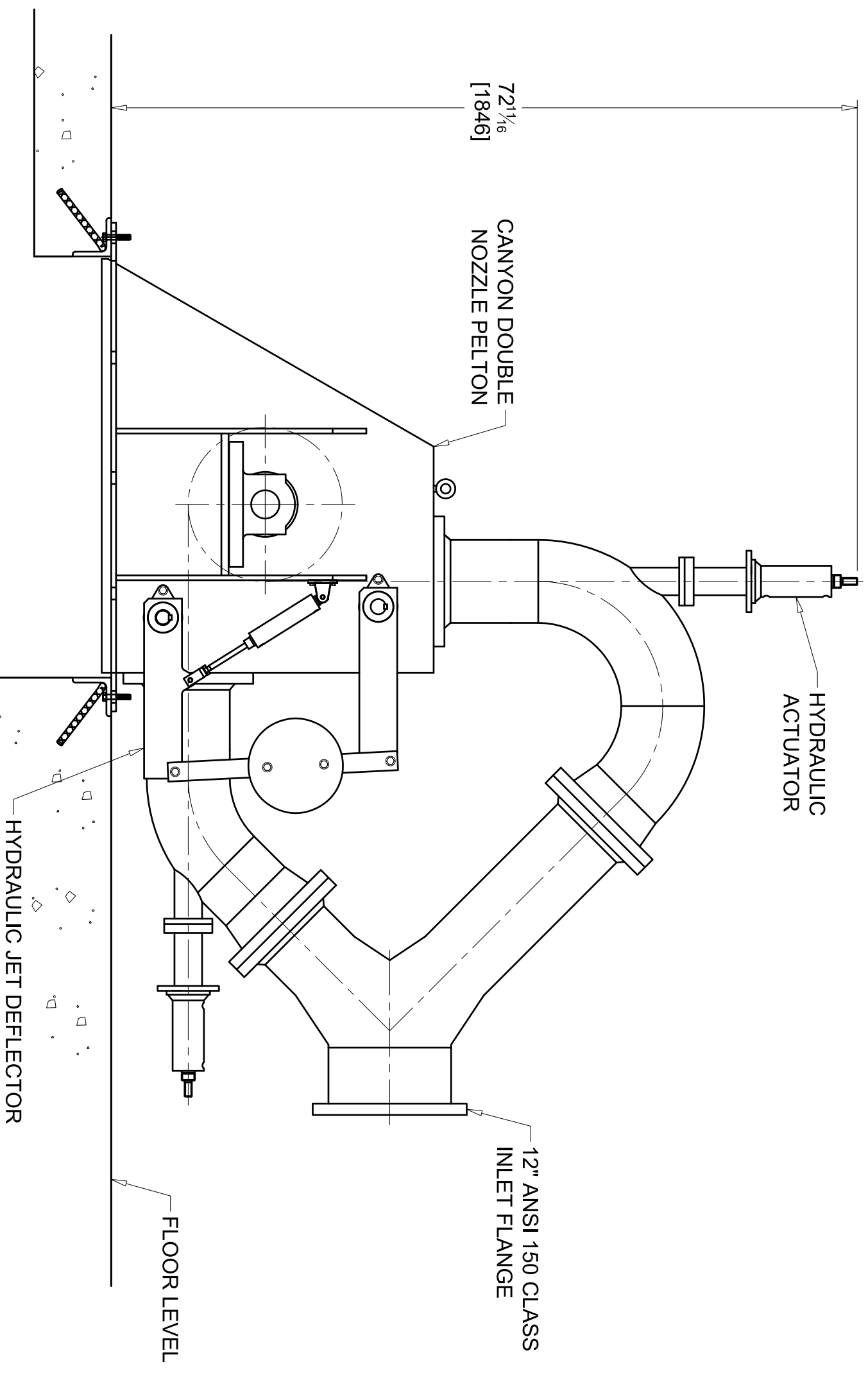
RELATED, IN WHOLE OR PART, TO THIS AGREEMENT. SLVREC SHALL NOT BE LIABLE IN ANY EVENT FOR CONSEQUENTIAL DAMAGES.

- (c) The Member is solely responsible for insuring his/her facility complies with all applicable regulations including, but not limited to, laws, regulations, ordinances, Cooperative and Cooperative Power Supplier tariffs, policies and directives.





REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



DIMENSIONS IN INCHES [mm] ARE APPROXIMATE  
NOT INTENDED FOR CONSTRUCTION

1525-2 EXAMPLE

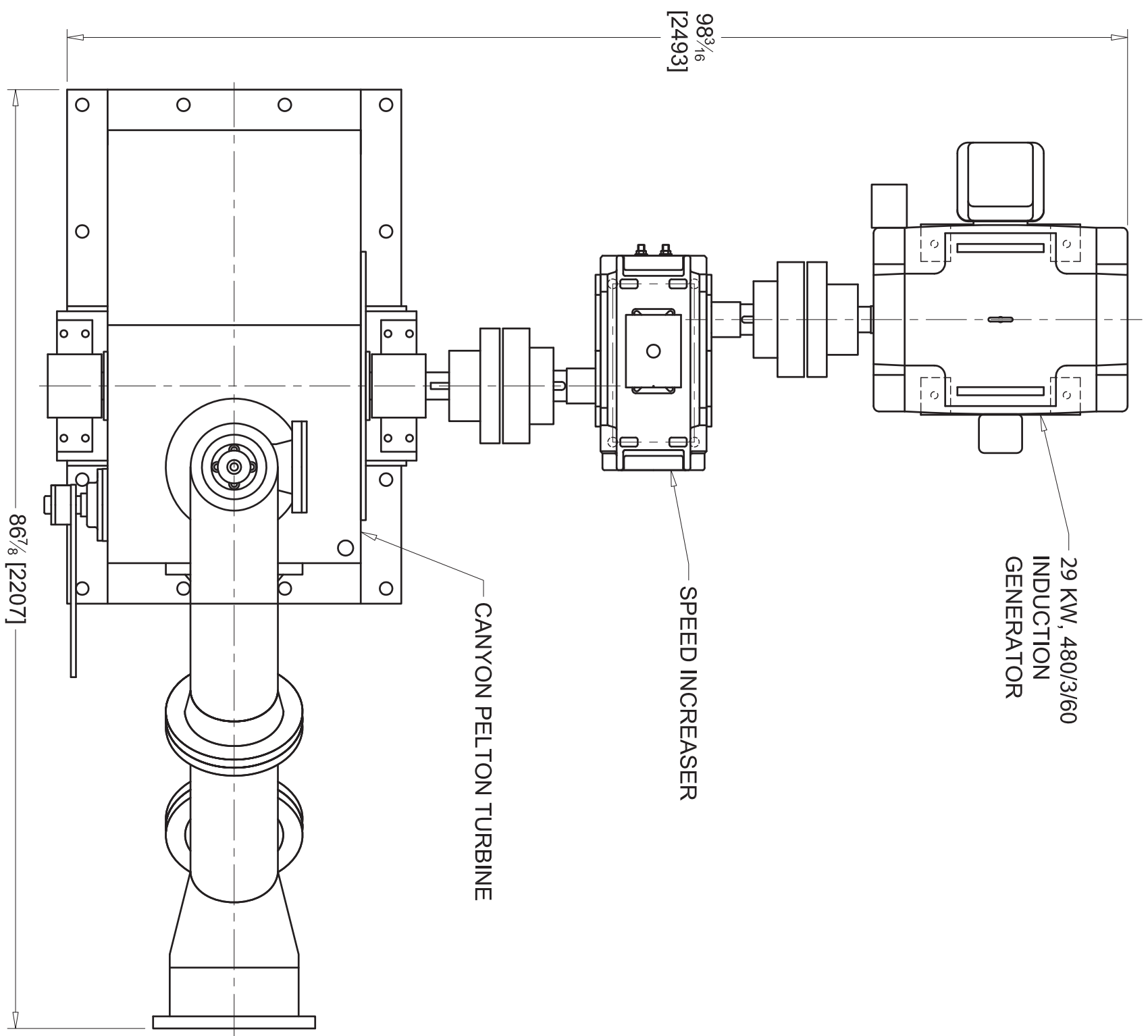


5500 Blue Heron Lane  
Deming, Washington 98244  
(360) 592-5552

the water power division of Canyon Industries, Inc

FILE: ELEVATION VIEW DATE: 2010-11-01

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



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NOT INTENDED FOR CONSTRUCTION

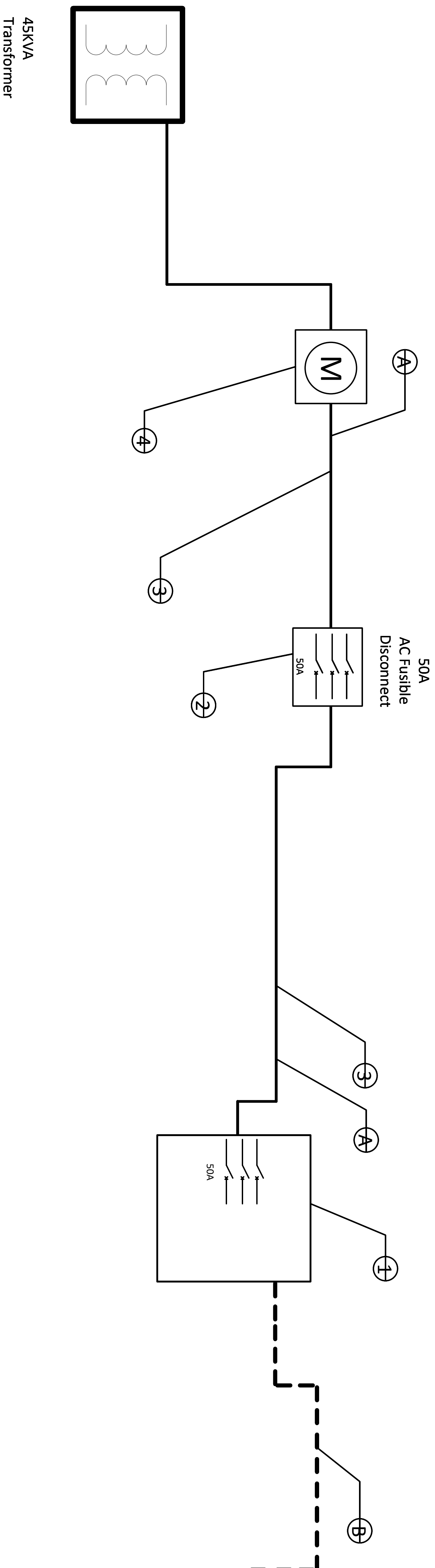
1525-2 ACTUATED GEARDRIVE PLAN



5500 Blue Heron Lane  
Deming, Washington 98244  
(360) 592-5552

the water power division of Canyon Industries, Inc

FILE: PLAN VIEW DATE: 2016-03-25



**Wire Schedule:**

- A. (4) #6 THHN 600V rated
- B. #4 CU Equipment ground

**Equipment Schedule:**

1. Canyon Industries 29KW (23KW rated) Hydro Turbine generator package.
2. 50A 600V rated fusible blade type lockable disconnect w/ 50A fuses
3. 1" Sch 40 GRC
4. Production meter (provided by SLV REC)

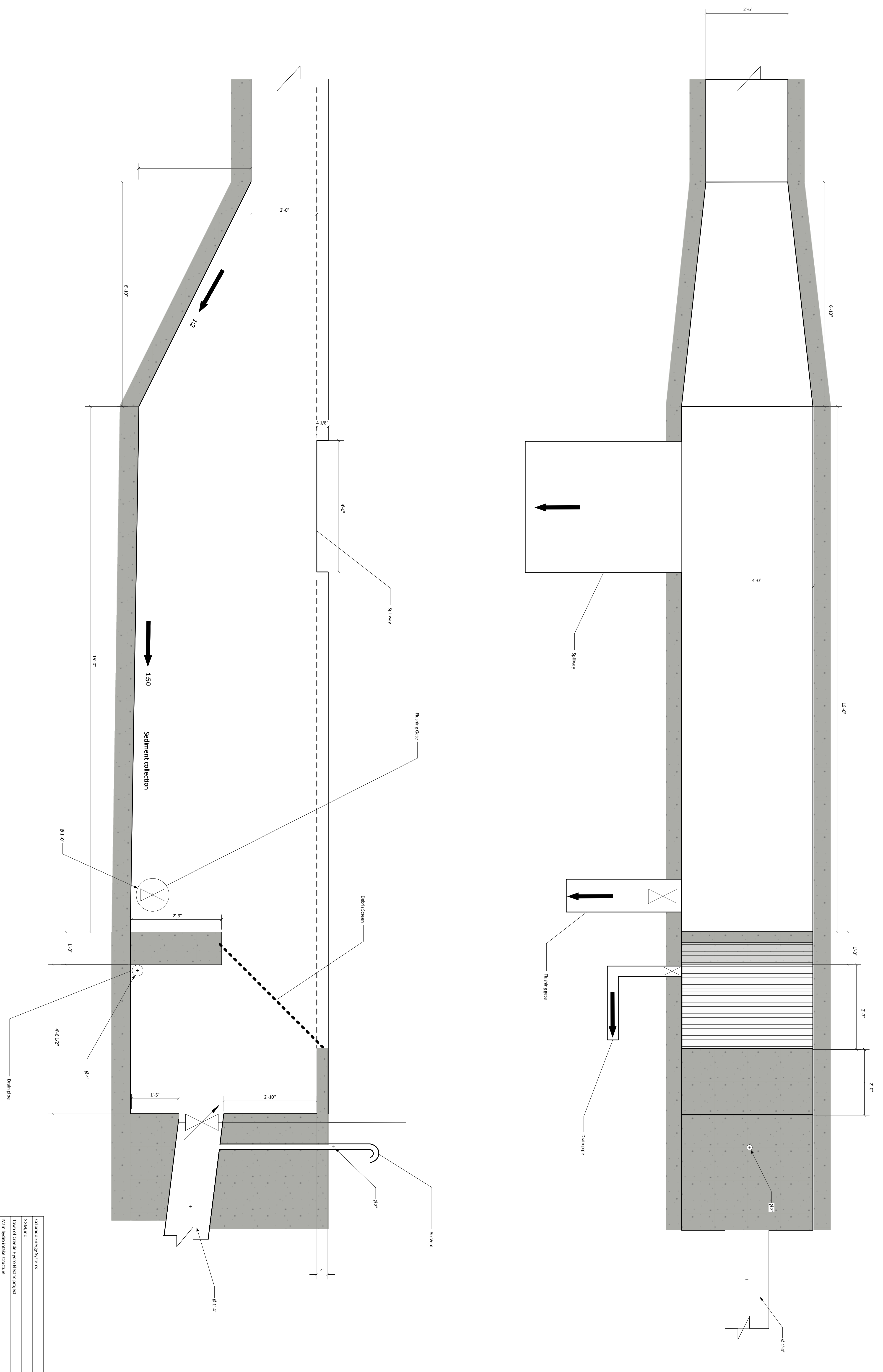
Colorado Energy Systems

Drawn By: I. Moritz

Creede Hydro Project

Creede, CO

9/14/2020



Chicago Energy Systems	
SKM, Inc.	
Team of Crede Hydro Electric Project	
Main Hydro intake structure	
9/14/2020	
Sheet	3/4" x 1"



Intake Location

		Location																
		7771705	38002905	55443405	733382405	756283106	757673505	869051506	869060405	6505970805	6510080507	7000089700	7000332900	7000333000	7000549600	7000604402	869010805	6508830905
		kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
	Jan-18	6615	326	14159	576	402	1900	1550	1673	937	364	flat rate	192	105	412	3655	264	937
	Feb-18	6370	56	14301	698	1168	1894	1806	1816	3	376	flat rate	189	103	1619	4105	481	974
	Mar-18	4550	0	12691	428	1132	141	1503	1648	3	325	flat rate	88	103	0	4220	712	840
	Apr-18	7464	0	12925	496	1220	1731	1706	1993	3	334	flat rate	132	76	0	3542	345	943
	May-18	6981	2	13556	484	863	1322	1322	7744	0	218	flat rate	127	76	0	3799	217	792
	Jun-18	7146	274	22719	512	430	944	214	15123	1	184	flat rate	109	67	0	4008	351	716
	Jul-18	6683	1087	29351	418	443	574	148	16745	0	121	flat rate	103	72	56	4386	261	574
	Aug-18	6789	1339	22739	415	438	469	117	3882	0	163	flat rate	82	78	231	4645	208	469
	Sep-18	6957	1208	20296	436	423	593	116	3424	0	88	flat rate	91	84	30	3487	264	1208
	Oct-18	6888	1125	18434	398	406	564	156	3440	0	596	flat rate	110	64	47	3716	226	0
	Nov-18	7391	1067	14073	474	414	1153	564	1938	1	270	flat rate	112	23	0	4064	289	0
	Dec-18	7576	962	12512	408	415	1605	1000	1656	3	285	flat rate	112	23	0	4064	244	0
	Annual Aggregate Total	81410	7446	207756	5743	7754	12890	10202	61082	951	3324	flat rate	1447	874	2395	47701	3862	7453

		Locations																
		7771705	38002905	55443405	733382405	756283106	757673505	869051506	869060405	6505970805	6510080507	7000089700	7000332900	7000333000	7000549600	7000604402	869010805	6508830905
		kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
	Jan-19	8098	2491	12544	503	473	1248	1182	1669	4	547	flat rate	134	25	679	4256	290	0
	Feb-19	5482	2737	13674	516	928	1251	1046	1696	5	596	flat rate	129	24	2017	5099	1201	0
	Mar-19	4426	977	13642	580	38	1049	1053	1688	2	894	flat rate	69	21	0	4439	1041	0
	Apr-19	4060	820	13174	526	19	598	266	1676	1	456	flat rate	29	19	0	4483	204	0
	May-19	4216	840	14658	441	9	588	342	2566	3	444	flat rate	29	16	0	4499	244	0
	Jun-19	4041	918	21288	377	25	488	121	4370	0	81	flat rate	28	17	0	4624	209	0
	Jul-19	3940	1199	28672	504	20	465	111	8891	0	1046	flat rate	29	18	0	4975	302	0
	Aug-19	3385	962	23742	446	23	682	108	3816	0	589	flat rate	31	18	20	4741	203	0
	Sep-19	6521	850	18420	518	24	554	103	3565	0	59	flat rate	34	21	0	3909	228	0
	Oct-19	9091	757	13266	652	76	728	328	2532	2	529	flat rate	37	22	0	4022	1243	0
	Nov-19	7253	723	11357	582	28	1355	1374	1796	2	787	flat rate	39	24	0	4861	1220	0
	Dec-19	6622	882	12222	675	34	1854	1806	1773	5	919	flat rate	68	25	0	5181	2102	0
	Annual Aggregate Total	67135	14156	196659	6320	1697	10860	7840	36038	24	6947	flat rate	656	250	2716	55089	8487	0
	Total kWh consumed	Size (KW)	2018	2019	AVG	KWH/Yr	%											
			462,290	414,874	438,582													
	Target Offset (95%)					394,130	95											
	Main Hydro Offset	23				191,406	46											
	Upper Hydro Offset	5				41,610	10											
	Total Hydro Offset	28				233,016	56											
	Ground mount PV Offset	93				162,823	39											
	Total Renewable generation					395,839	95*											

\*Note: Percentage based on lower kWh consumption in 2019 per LED lighting upgrades completed.



To: Matt Hutson  
SGM Inc

Project: Creede Hydro Project Budget 5KW

Date: 9/25/2020

Project Overview:

Provide and install a turnkey 5KW grid tied hydroelectric system. System will be interconnected to SLVREC grid under Net Meter Distributed Generation facility agreement, to offset City of Creede electrical utility consumption.



Scope of Work:

Intake:

Excavation, modification of intake system, including diversion of water away from intake structure area during construction. Concrete work for intake system, including forming, pouring, and testing.

Penstock:

Utilization of 8" existing penstock beginning at new intake structure and continuing underground to the hydro turbine building. Modification of existing water hydrant to connect to hydro turbine

Generator building:

Construction of 12' x 15' steel building to house hydro turbine, generator, and controls. Excavation of footprint and tail race included. Concrete work for generator building including forming, pouring, and testing. Tail race for hydro turbine outlet will be installed during construction of building.

Hydroelectric generator:

Provide and install Canyon Industries 7.4KW (5KW site rated) Hydro Electric generator system to include the following:

Turbine:

Canyon horizontal dual nozzle Pelton turbine with the following features.

- Manganese bronze turbine runner, ground, polished and balanced
- Upper 316 stainless steel needle nozzle and nozzle beak with hand wheel
- Lower bore aligned, fixed interchangeable nozzle
- Jet deflector system with electromagnet
- Fabricated steel housing, nozzle bodies and inlet piping, powder coated
- Pillow block mounted main shaft spherical roller bearings
- Turbine shaft labyrinth seals with centrifugal slinger and splash plate
- Design flow 0.9 cfs at 104 feet net head
- Turbine/generator shaft speed 1200 RPM, nominal
- Speed pickup bracket and toothed wheel to controls requirements
- Direct drive coupling set

Generator:

- US Motors, 1200 rpm, 7.4 kW, 480/3/60, induction generator with winding thermostats and space heaters. Two bearing design for use with flexible coupling between turbine and generator shaft.

Switchgear and Controls:

- Custom switchgear and controls panels to parallel the generator with the local electrical grid and provide protective relays. Protective relays will be utility grade. A digital multimeter or analog gauges will provide readouts for system function. Switchgear and controls panels to be UL508A listed.

Electrical Connection to SLVREC:

Coordinate and complete electrical work for interconnection to utility grid based on electrical one line. Interconnection will be made at 480V 3 Phase to nearest utility line approved by SLVREC. Electrical work to be completed by CO State licensed electrician and will be permitted and inspected by AHJ. SLVREC Net Meter Distributed Generation application will be completed and approved prior to interconnection.

Commissioning and testing:

System will be tested and commissioned by Canyon Industries representative prior to startup. Owner training and orientation will be included at time of commissioning.

Permitting:

Excavation, concrete, and electrical permitting included. Any water rights, Army Corp of Engineers, BLM, or USFS permitting is the responsibility of the owner.

Project Budget:           \$269,900.00 (subject to change at time of contract award)



To: Matt Hutson  
SGM Inc

Project: Creede Hydro Project Budget

Date: 9/22/2020

Project Overview:

Provide and install a turnkey 23KW grid tied hydroelectric system. System will be interconnected to SLVREC grid under Net Meter Distributed Generation facility agreement, to offset Town of Creede electrical utility consumption.

## Scope of Work:

### Intake:

Excavation for intake system, including diversion of water away from intake structure area during construction. Concrete work for intake system, including forming, pouring, and testing.

### Penstock:

Installation of 16" penstock beginning at intake structure and continuing along the improved flume to the hydro turbine building. Penstock will be routed above grade and anchored to the flume wall using appropriate brackets to allow for expansion/contraction of penstock during normal operation. Penstock shall be HDPE or PVC (with UV wrap) with necessary adhesion (either glue or weld) according to manufacturer's installation guidelines.

### Generator building:

Construction of 15' x 20' steel building to house hydro turbine, generator, and controls. Excavation of footprint and tail race included. Concrete work for generator building including forming, pouring, and testing. Tail race for hydro turbine outlet will be installed during construction of building.

### Hydroelectric generator:

Provide and install Canyon Industries 29KW (23KW site rated) Hydro Electric generator system to include the following:

#### Turbine:

Canyon horizontal dual nozzle Pelton turbine with the following features.

- CF8M stainless steel turbine runner, ground, polished and balanced
- 316 stainless steel needle nozzles and nozzle beaks with hydraulic actuators and 4-20 mA position transducers.
- Jet deflector system with hydraulic actuator and full open limit switch
- Fabricated steel housing, nozzle bodies and inlet manifold, powder coated
- Turbine main shaft labyrinth seals with centrifugal slinger and splash plate
- Pillow block mounted double row spherical roller bearings, grease lubricated
- Design flow 4 cfs at 100 feet net head
- Turbine shaft speed 525 RPM
- Structural steel turbine, geardrive and generator mounting frames
- Hydraulic power unit to support actuation of nozzles and jet deflectors
- Flexible direct drive coupling sets
- Toothed wheel and speed pickup bracket

#### Generator:

• US Motors or equivalent 29 kW, 1800 RPM, 480 VAC, 60 hertz, 3 ph., induction generator, complete with shaft and bearings designed for direct coupling between the turbine and geardrive shaft. To include winding thermostats, vibration switch and space heaters.

#### Gear Drive:

• Flender single stage gear drive for coupling between the turbine and the generator. Nominal gear ratio 3.4:1.0.

#### Switchgear and Controls:

• Custom US manufactured low voltage switchgear and controls panels to parallel the generator with the local electrical grid. Protection by utility grade multifunction relay, PLC based automatic control, hard wired manual control, digital multimeter and operator interface screen.

Electrical Connection to SLVREC:

Coordinate and complete electrical work for interconnection to utility grid based on electrical one line. Interconnection will be made at 480V 3 Phase to nearest utility line approved by SLVREC. Electrical work to be completed by CO State licensed electrician and will be permitted and inspected by AHJ. SLVREC Net Meter Distributed Generation application will be completed and approved prior to interconnection.

Commissioning and testing:

System will be tested and commissioned by Canyon Industries representative prior to startup. Owner training and orientation will be included at time of commissioning.

Permitting:

Excavation, concrete, and electrical permitting included. Any water rights, Army Corp of Engineers, BLM, or USFS permitting is the responsibility of the owner.

Project Budget:           \$608,800.00 (subject to change at time of contract award)