Presentation Outline

- Boulder’s Hydro System
- Boulder Canyon Hydro Modernization Project
- Construction Photos
Boulder’s Hydro System
Boulder Hydro System

FIGURE 2. A DIAGRAM OF BOULDER'S HYDROELECTRIC SYSTEM
Source Water Hydro Plants

Silverlake Hydro (1998)
- Pelton Turbine
- Turbine/Generator – Gilkes/Alconza
- 3.2 MW @ 31 cfs
- 1,400 ft Head
- Annual rev $500,000 with 17,000,000 kWh
- FERC Licensing – Conduit Exemption

Lakewood Hydro (2004)
- Pelton Turbine
- Turbine/Generator – Gilkes/Alconza
- 3.5 MW @ 34 cfs
- 1,550 ft Head
- Annual rev $800,000 with 19,621,800 kWh
- FERC Licensing – Conduit Exemption
Source Water Hydro Plants

Betasso Hydro (1987)
- Pelton Turbine
- Turbine/Generator – Kunming/Cumming
- 3.1 Mw @ 33 cfs
- 1,300 ft Head
- Annual rev $540,000 with 9,056,000 kWh
- FERC Licensing – Conduit Exemption

Boulder Canyon Hydro (1910)
- Originally two Pelton Turbines
- Turbine/Generator – Pelton Water/GE
- 10 MW each @ up to 75 cfs total
- 1,830 ft Head
- Annual rev $800,000 with 19,621,800 kWh
- FERC Licensing – Conduit Exemption
- Plant Modernization Completed in 2013
Treated Water Hydro Plants

Maxwell Hydro (1985)
- Francis Turbine (pump/generator)
- Turbine/Generator – Cornell/GE
- 95 kW @ 5 cfs
- 200 ft Head
- Annual rev $21,000 with 483,000 kWh
- FERC Licensing – Conduit Exemption

Kohler Hydro (1986)
- Two Francis Turbines (pump/generator)
- Turbine/Generator – Cornell/Marathon XRI
- 150 kW each @ 3.6 cfs
- 240 ft Head
- Annual rev $35,000 with 797,000 kWh
- FERC Licensing – Conduit Exemption
Orodell Hydro (1987)
- Francis Turbine
- Turbine/Generator – Cornell/Primeline
- 200 kW @ 8 cfs
- 410 ft Head
- Annual rev $18,600 with 540,000 kWh
- FERC Licensing – Conduit Exemption

Sunshine Hydro (1986)
- Francis Turbine
- Turbine/Generator – Hangzhou/Unimega-Hitachi
- 800 kW @ 31 cfs
- 750 ft Head
- Annual rev $136,000 with 3,050,000 kWh
- FERC Licensing – Conduit Exemption
City of Boulder Hydro Summary

- Total Nameplate Generating Capacity ~ 16MW
- Xcel Energy & Tri-State Power Sales Contracts
- 2014 Total Hydro Revenue ~ $2.4M
- 2014 Total Generation ~ 52,015 MWh
- Annual Generation ~ supply 5,200 homes
- Existing municipal water supply facilities – no new dams or transmission lines
Boulder Canyon Hydro
Commissioning day June 1910
Boulder Canyon Hydro (BCH) Modernization Project

- Originally completed in 1910 by Colorado Power Co then PSCO
- Originally used as a peaking plant for Boulder/Denver
- Had two existing 10MW Pelton Units. (Originally two 7MW turbines in 1936)
- Turbines built by the Pelton Water Wheel Company
- Current available flows are much less due municipal water usage
WATER FLOWS FROM "BARKER RESERVOIR" THROUGH THE "GRAVITY LINE" TO THE "FOREBAY." HERE IT IS STORED TEMPORARILY, PENDING ITS 1835' DROP THROUGH THE PRESSURE LINE TO THE PELTON WHEELS IN THE "POWER HOUSE." "BARKER RESERVOIR" HAS A STORAGE CAPACITY OF 15,000,000 KILOWATT HOURS OF WATER. THIS ENERGY WOULD BURN A 100 WATT LIGHT FOR 12,264 YEARS. "BARKER DAM" WAS CONSTRUCTED IN 1909 AT A COST OF $300,000 DOLLARS. 4,000 CARLOADS OF CONCRETE WERE USED, AND THE DAM'S SAFETY FACTOR IS 130 TO 1. IT STANDS 177' FROM BED ROCK AND IS 787' LONG.

"GRAVITY LINE" IS CONSTRUCTED OF 36" CONCRETE PIPE AND WILL DELIVER 50 CUBIC FEET PER SECOND AT KOSSLER FOREBAY. LAID ON A 0.5% SLOPE, THE LINE FALLS ONLY 335' IN THE 11.7 MILES THAT IT TRAVELS.

"KOSSLER FOREBAY" WITH A CAPACITY OF 165,000 KWH OF WATER, CARES FOR THE PLANT DURING PEAK LOADS WHEN CONSUMPTION EXCEEDS THE GRAVITY LINE CAPACITY.

"PRESSURE LINE" DROPS 1835' TO THE "POWER HOUSE" AND DELIVERS ITS WATER UNDER A STATIC HEAD OF 800 LBS. PER SQUARE INCH. "POWER HOUSE" CONTAINS TWO 2,000 HORSEPOWER PELTON WHEELS. THEIR GENERATING CAPACITY IS 2,000 KVA. POWER IS TRANSMITTED TO DENVER AT 100,000 VOLTS.
BCH – Original Powerhouse Design
BCH – Present Powerhouse Layout
BCH – Main Project Features

- Turbine/Generator
  - Canyon Hydro Pelton unit/horizontal shaft
  - Hyundai Generator
  - flow range: 4 to 37 cfs
  - 30% efficiency increase
- Ultrasonic Flowmeter
- Turbine Isolation Valve – 24” High Pressure Ball Valve
BCH Modernization Project Schedule

• 2005 – Feasibility Studies
• 2009 – DOE ARRA Funding Announcement
• Spring 2010 – Start Design
• December 2010 – Turbine Package Awarded
• October 2011 – Construction Package Awarded
• Late Fall 2012 – Anticipated Construction Completion
• Commissioning Date June 13\(^{th}\) 2013
Construction Photos
Old runner removal (15 tones)
Old Pelton runner damage
Concrete Work for new turbine casing
Upper Turbine Nozzle Installation
Nozzles being installed
New Pelton Runner
New Turbine
Removing Old Transformer
New Transformer Mobilizing
BCH Modernization Project Participants

City of Boulder - Owner

Department of Energy – Federal Funding Agency

AECOM – Design Engineer

Canyon Hydro – Turbine/Generator Supplier

URS – Historical Documentation

Gracon – Construction Contractor
Thank You

gesnerj@bouldercolorado.gov
(720) 564-2310

June 14th, 2016
City of Boulder Hydro Contacts

Jake Gesner
Hydroelectric Manager
GesnerJ@bouldercolorado.gov

Joe Taddeucci, PE
Utilities Engineering Project Manager
TaddeucciJ@bouldercolorado.gov

This material is based in part upon work supported by the Department of Energy under Award Number(s) DE-EE02675.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.