SWT HYDROPOWER PROGRAM OVERVIEW

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Discussion Topics

- Hydropower 101
- The Corps History in Hydropower
- Power Marketing Administrations (PMAs)
- Tulsa District Rehabilitation Projects
- Trends in the Hydropower Industry
- Hydropower Environment in the Future
HYDROPOWER 101

• People have a long history of using the force of water flowing in streams and rivers to produce mechanical energy.

• Hydropower was one of the first sources of energy used for electricity generation and is the largest single renewable energy source for electricity generation in the United States.

• In 2017, hydroelectricity accounted for about 7.5% of total U.S. utility-scale electricity generation and 44% of total utility-scale electricity generation from renewable energy sources. Hydroelectricity’s share of total U.S. electricity generation has decreased over time, mainly because electricity generation from other sources has increased.
NOTIONAL HYDROPOWER PLANT

The first law of thermodynamics, aka Law of Conservation of Energy, states that energy can neither be created nor destroyed; energy can only be transferred or changed from one form to another.

Potential → Kinetic → Mechanical → Electrical → $$$$$$

Diagram showing the flow of energy from potential to kinetic to mechanical to electrical energy.
NATIONAL HYDROPOWER

Federal and Non-Federal FERC Regulated Hydroelectric Projects in the United States

USACE HYDROPOWER

READY TODAY, WHILE SETTING THE CONDITIONS FOR FUTURE SUCCESS

- 1925 Rivers and Harbors Act
  USACE authorized to explore cost and feasibility of identifying navigable rivers for power generation

- 1934 Bonneville Dam, Columbia River
  First USACE project to include hydropower, 40 miles east of Portland, OR

Today
- 375 generating units at 75 dams
- 21,000 MW total capacity
- 25% of U.S. hydropower
- 3% of U.S. total electric capacity
- 5th largest U.S. electric supplier
- 70 Billion KWH annually
USACE produces the power & works closely with all four DOE Power Market Administrations (PMA) across the country. PMAs have contracts to sell the power to customers, receive receipts, and send funds to the treasury.

Partners in the Hydropower Modernization Initiative

- Southwestern Power Administration (SWPA)
- Southeastern Power Administration (SEPA)
- Western Area Power Administration (WAPA)
- Bonneville Power Administration (BPA)
Southwestern Power Administration Region

Southwestern Power Administration markets power in a six state marketing area serving:
- 21 cooperatives
- 78 municipalities
- 3 military installations
- Over 8 million end users

USACE operations within the Southwestern Power Administration footprint spans four states and consists of 24 Hydropower Plants across six Districts in three Divisions.

Southwestern Power Administration markets 2,052.5 megawatts (MW) of capacity and an average annual energy production of 5,570,000 megawatt-hours (MWh).

Estimated Greenhouse Gas Emissions Offset Per Year (SWPA Region)
- Carbon Dioxide: 4.6 million tons
- Sulfur Dioxide: 13,900 tons
- Nitrogen Oxides: 5,800 tons

Estimated Fuel to Produce Equivalent Energy Per Year (SWPA Region)
- Barrels of Fuel Oil: 9.5 million
- Tons of Coal: 2.9 million
- Cubic Feet of Natural Gas: 47.5 million

SWF Fleet Units Year Capacity (MW)
- R. D. Willis 2 1989 7.4
- Sam Rayburn 2 1965 60
- Whitney 2 1953 42
- Total 6 109.4

SWL Fleet Units Year Capacity (MW)
- Beaver 2 1965 112
- Bull Shoals 8 1953 340
- Dardanelle 4 1965 140
- Greers Ferry 2 1964 96
- Norfolk 2 1944 80.5
- Ozark 5 1973 100
- Table Rock 4 1959 200
- Total 27 1068.5

SWT Fleet Units Year Capacity (MW)
- Broken Bow 2 1970 100
- Denison 2 1945 70
- Eufaula 3 1965 90
- Fort Gibson 4 1953 45
- Keystone 2 1968 70
- R. S. Kerr L&D 4 1971 110
- Tenkiller Ferry 2 1954 39.1
- Webbers Falls L&D 3 1974 60
- Total 22 584.1

SWD Fleet Units Avg. Age Capacity (MW)
- Total 55 52 1762
A Memorandum of Agreement (MOA) was signed in 1999 by the USACE, Southwestern Power Administration, and the City of Jonesboro, AR (Southwestern Power Resource Association), to allow Southwestern customers to fund non-routine maintenance at Corps projects by diverting power receipts that would normally be returned to the treasury back to the power plant for rehabilitation.

A collaboration among the hydropower customers, the Corps, and Southwestern allows the prioritization of maintenance to provide the greatest benefit.

To date, 135 Sub-agreements have been executed to perform work in Tulsa District.

The total amount approved for funding is approximately $360M.
LOCALLY, SWT:
Eight (8) Plants:
	Texoma- 1949
		2 units- 70 MW
	Eufaula- 1965
		3 units- 90 MW
	Ft Gibson- 1953
		4 units- 50 MW
	Keystone-1968
		2 units- 70 MW
	Tenkiller- 1954
		2 units- 39.1 MW
	RS Kerr- 1971
		4 units- 110 MW
	Broken Bow- 1970
		2 units- 100 MW
	Webbers Falls- 1974
		3 units- 60 MW

Approx. 600 Megawatts of capacity
Customers are Rural Electric Coops
HYDROPOWER PLANT REHABILITATION

1 Bridge Crane
2 Tailrace Crane
3 Intake Crane
4 Intake Roller Gates, Intake Bulkheads, Tailrace Bulkheads
5 Transformer
6 Oil Containment
7 Switchgear, Bus, Panels
8 Motor Control Centers
9 Turbine Rehabilitation
10 Generator Rewind
### TULSA DISTRICT TURBINE/GENERATOR
**PROJECTED TIMELINES AND PROGRAM ESTIMATE**

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Cost for turbine/generator; Does not include balance of plant.
Webbers Falls Major Rehabilitation

• Project Scope: Replace three turbines, rewind three generators and rehabilitate all cranes, tailrace and intake gates and bulkheads.

• Total Project cost, including turbines, generator, gates, cranes, governors and misc: $88.2M ($83.8M customer funded)

• 2 MW per unit (8.5%) increase by up-rating.

• Anticipated Turbine Completion Date: 19 September 2018

• Commence Rewind of the last generator October 2018
POWERHOUSE CUTVIEW

CRANES

GENERATOR

EXCITER

GOVERNOR

INTERMEDIATE SHAFT

RUNNER

SPEED INCREASE

MAIN SHAFT

INCLINED-AXIS TURBINE
NEW RUNNER DESIGN
KAPLAN RUNNER CONFIGURATION
OLD VS. NEW
GATE BARREL REMOVAL
WICKET GATES
LOWER MAIN SHAFT
INTERMEDIATE SHAFT
DENISON TURBINE REPLACEMENT
SCOPE AND BUDGET

- Project Scope: Replacement of two francis turbines, installation of new digital governors, gas insulated 3 phase transformers, switchgear, bus and rehabilitation of the bridge crane.
- Turbine efficiency increase from 40 MW to 50 MW
- Total Customer Funding - $50,295,000
Denison Rotor Removal
Old Runner Removal/New Runner Delivery

Removed on 2 Feb 2018
Inner Head Cover (Bearing Housing) Condition

Rust and pitting

Large rust flakes on lower ring.

Cleaning Rust and grease on Bearing Housing

US Army Corps of Engineers

U.S. Army
R. S. Kerr Major Rehabilitation

Scope, Cost and Agreements

- Replace four Kaplan turbines, rewind four generators, refurbish governors and exciters, rehabilitate bridge and intake crane, replace tail race crane, replace transformers, rehabilitate draft tube and roller gates and construct new roller gate and draft tube gates.

- Energy Output 36MVA/unit

- Total Project Cost: $192,144,000

R. S. Kerr Major Component Award Schedule

- New Draft Tube Crane Award – 6 Dec 2018
- Transformer Award – 2 Dec 2018
- Bridge Crane Rehab Award – 15 Dec 2018
- Modernization of Electrical Infrastructure Award – 28 Mar 2019
- New Gates and Bulkhead Award – 7 Mar 2019
- Existing Gates and Bulkhead Minor Repair Award – 7 Mar 2019
- Turbine & Generator Award – 26 Oct 2019

R. S. Kerr Turbine Generator Schedule

Turbine Generator Design Completion: 16 July 2018
Turbine Generator Contract Award: 26 Oct 2019
Model Test, Design, and Fabrication: Jan 2019 to Dec 2020
Unit 1 Construction Period: 26 Oct 2022 to 26 Sep 2022
Unit 2 Construction Period: 26 Sep 2022 to 25 Oct 2023
Unit 3 Construction Period: 25 Oct 2023 to 24 Oct 2024
Unit 4 Construction Period: 24 Oct 2023 to 24 Oct 2025
HYDRO TRENDS TODAY

– Unit and Plant optimization
– New Technologies/Digital Equipment
– Cyber Protection, GDACS/SCADA, Instrumentation for the Corps & Others
– Renewable Energy Integration
– Investing in Modernization/Rehabilitation of our Infrastructure
THE HYDROPOWER ENVIRONMENT IN THE NEXT 30-50 YEARS

– High Certainty of increasing Large Capital Investment to Remodernize Corps’ hydropower fleet.

– High value energy resource; Base, Peak, Voltage Support, Frequency Response/Regulation, major integrator of other renewables

– Increased Emergency Response, Aging Fleet, Forced Outages, Trouble shooting, Emergency Repairs, Forensics

– SCADA & Industrial Control System Emerging Requirements, Compliance and Reliability burden, cyber security assurance
Questions ?