

Cumberland River System Optimization

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District Commander

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US Army Corps of Engineers
BUILDING STRONG

Purpose

To present Team Cumberland the Nashville District's proposed optimization plan, specifically covering the project major work items, spend plan, and milestones.



Agenda

- **The Proposal**
- **The Benefits**
- **Optimization Defined**
- **Proposed Work Items**
- **Costs**
- **Schedule**
- **Funding**
- **Questions**



The Proposal...

The LRN proposed Optimization plan is a six-year plan (FY16 to FY21) of Master Plan-approved projects that will utilize existing Legacy Funds to optimize the Cumberland River power plants. It will pay for itself within two years of completion (FY24) and result in increased power production, and increase generation efficiency by 2 to 5 percent (a benefit annually of at least \$2.8M).



The Benefits

Why Optimization?

- ▶ Pays for itself within 8 years (two years after completion)
- ▶ Benefits begin accruing immediately upon completion of first project
- ▶ Increased Revenue (~\$2.8M annually) thru 2-5% increase in power production efficiency
- ▶ More dependable and reliable power by improved cyber security and adaptability
- ▶ Reduces Long Term Maintenance Costs



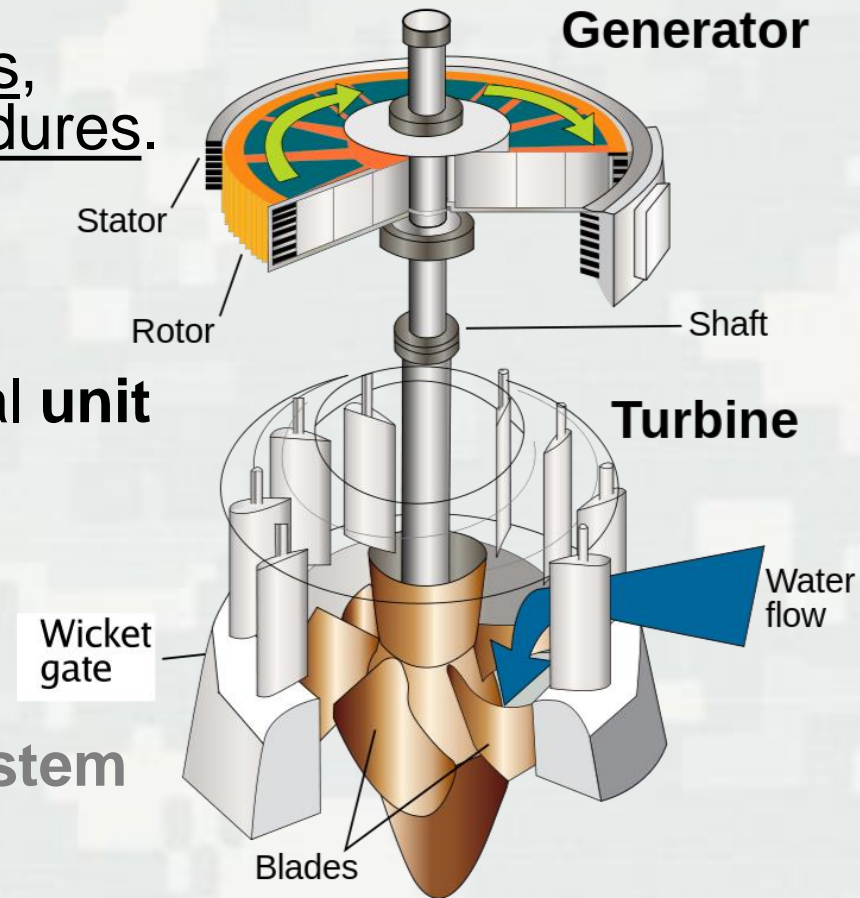
****All Work Items are included in the Master Plan**



Optimization

- Maximizing the energy produced from a given volume of water.
- Achieved by **modifying** the units, plants, control systems and procedures.
- **Three types of Optimization:**

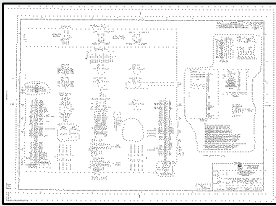
- ▶ **Type 1** – optimize the individual **unit**
- ▶ **Type 2** – optimize the **plant**
- ▶ **Type 3** – optimize the **river system**



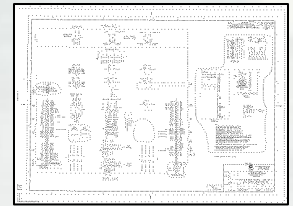
The Proposed Work Items

1. **Project Drawings updates**
2. **Installation of GDACS at all 9 plants and addition of advanced telemetry and head sensing.**
3. **Install digital turbine governors at three Kaplan turbine plants**
4. **Conduct Index Tests to determine proper blade/gate relationship, develop proper cam information.**





Update Project Drawings



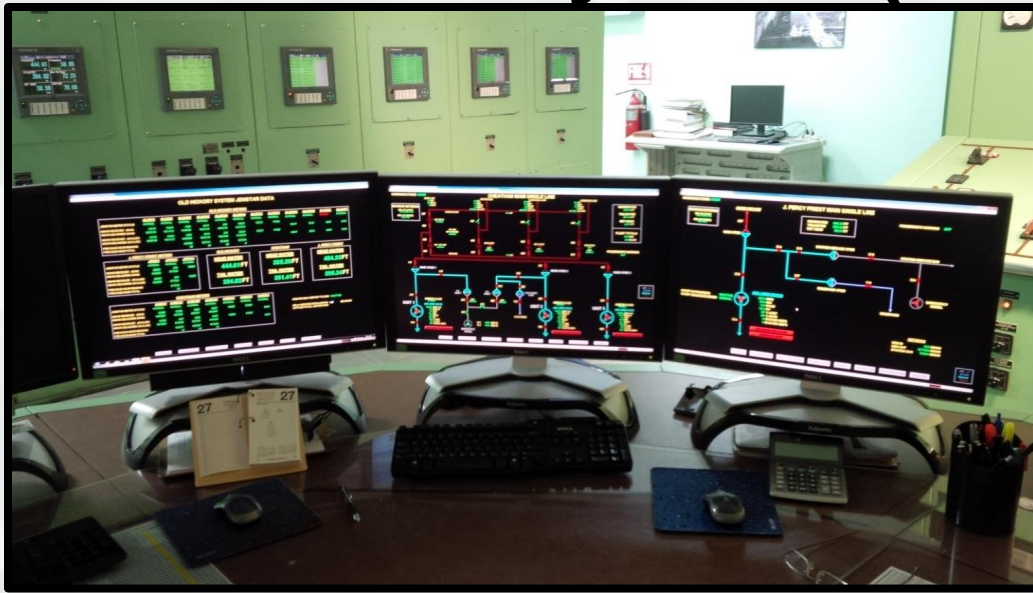
- **Systematic review, correction and digitization of component/system drawings**
- **Performed and funded by Nashville District**
- **Incorporates a review of system configuration and provides base drawings for all other hydropower rehabilitation program work.**

Preliminary Implementation Milestones

Authorization (Nashville Budget)	FY16
Substantially Complete	FY19
Closeout	FY20



Generic Data Acquisition & Control System (GDACS)



Preliminary Implementation Milestones

Authorization	FY16
PED Complete (1 st Plant)	FY17
PRC/PCC Review	FY17
Begin Acquisition	FY18
PRC/PCC Review	Annually
Substantially Complete	FY21
PRC/PCC Review	FY22
Closeout	FY22
Initial Accrual of Benefits	FY20

- Installation of **GDACS** at all 9 plants, adding advanced **telemetry** and head sensing.
- Replaces** existing SCADA.
- Provides extensive benefits (**troubleshooting, maintenance, DIACAP compliance support; commonality; T2 optimization, improved efficiency**)



Turbine Governors



- Install **digital turbine governors** at three Kaplan turbine plants:
 - ▶ Provides **increased control flexibility** of units
 - ▶ Allows **optimum gate/blade positioning**
 - ▶ **2%+ efficiency gains**
- **Benefits begin accruing upon completion of each project**
- **Extension of life maintenance** of mechanical governors at other plants

Preliminary Implementation Milestones	
Authorization	FY16
PED Complete (1 st Plant)	FY17
PRC/PCC Review	FY17
Begin Acquisition	FY17
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PRC/PCC Review	FY21
Closeout	FY22
Initial Accrual of Benefits	FY18



Index Tests

- Required to determine peak efficiency through **proper blade/gate relationship & proper cam data**
- Applied cam information can result in **efficiency gains of over 2%**
- Turbine **performance** may have **changed** since installation
- Aids **GDACS** performance



Preliminary Implementation Milestones	
Authorization	FY16
Barkley	FY16
Old Hickory	FY16
PRC Review	FY16-17
Cordell Hull	FY17
Wolf Creek	FY17
Dale Hollow	FY17
PRC Review	FY17-18
Center Hill	FY18
Laurel	FY18
J. Percy Priest	FY18
Cheatham	FY18
PRC Review	FY18-19
Closeout	FY18-19
Initial Accrual of Benefits	FY18



Performed in order of units likely to produce the greatest benefits first



Optimization Cost

Optimization Cost by Project	
Project	Amount (\$)
Drawings (USACE O&M funded)	2,500,000
GDACS	4,918,000
Governors	7,850,000
Index Testing & Cam Tables	1,020,000
Capital Project Total	\$13,788,000

Spending Plan by FY	
FY	Amount (\$)
16	750,000
17	2,560,000
18	3,163,000
19	3,107,000
20	2,911,000
21	1,297,000

This spend plan ensures that sufficient funds are available for contingency in legacy funds



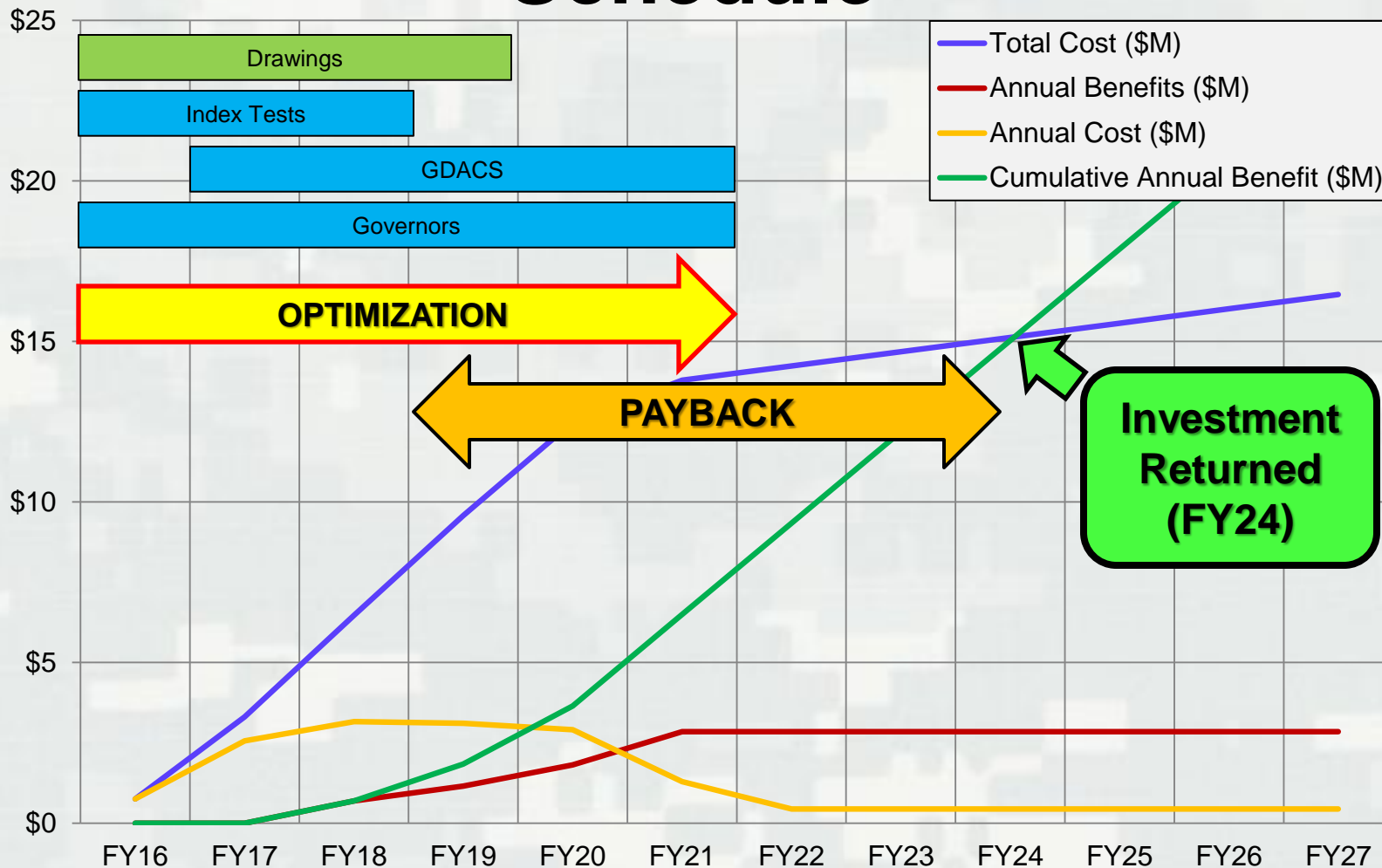
Optimization Order of Work

Index Test	Cam Table (follows Index Test)	Digital Governors	GDACS
Barkley	Barkley	Barkley	Center Hill
Old Hickory	Old Hickory	Old Hickory	Dale Hollow
Cordell Hull	Cordell Hull	Cordell Hull	Cordell Hull
Wolf Creek			J. Percy Priest
Dale Hollow			Cheatham
Center Hill			Old Hickory
Laurel			Barkley
J. Percy Priest			Laurel
Cheatham			Wolf Creek

Prioritized by “worst first” by remote/master groupings with much of work executed concurrently



Schedule



Optimization Implementation – 6 years
Optimization Capital Cost - \$13.8M
Payback Period – 8 years from start



Proposed Funding

Funding Source	Amount (\$)
O&M	\$2,500,000
Section 212	\$13,788,000

Legacy MOA	Current Allocation	Proposed Allocation
Emergent Work	\$12,458,709	\$1,108,063
Projects	\$5,199,354	\$4,550,000
Optimization	\$0	\$12,000,000
Total	\$17,658,063	\$17,658,063

- Funds optimization without putting current Legacy work items at risk by keeping sufficient contingency
- Accomplishes low risk /high pay off work utilizing available funds



Current Legacy MOA Funding

Legacy MOA		
Total Funds Received - \$45,000,000	Funds Remaining	Risk
Barkley Crane PED and Construction (FY08-09)	\$3,483,988	Low
Old Hickory Unit #4 PED (FY08-09)	\$706,276	Low
Center Hill Penstock/Water Passages PED (FY08-09)	\$126,831	Low
Center Hill MV Cables & Busses PED (FY08-09)	\$147,145	Low
System-Wide Turbine Governors PED (FY08-09)	\$680,676	Low
Laurel Unit 1 Assessment (FY08-09)	\$52,449	Low
Emergent Work Funds (FY05-06, 08-09)	\$12,458,709	N/A

Of the 6 Legacy project work items, 5 are studies/designs performed by USACE nearing completion with very low risk. The single construction work item has low risk that was reduced by implementing lessons learned on previous similar work.



Summary

Utilizing available Legacy MOA Emergent Work funds provides excellent short and long term benefits to USACE, Team Cumberland and ratepayers. It mitigates risk to current work by maintaining a sufficient contingency and provides tangible and cumulative benefits and an 8-year ROI.

- **Nashville O&M will** fund a portion of the work and all recurring costs
- **Optimization will:**
 - ▶ **Pays for itself within 8 years (two years after completion)**
 - ▶ **Benefits begin accruing immediately upon completion of first project**
 - ▶ **Increased Revenue (~\$2.8M annually) thru 2-5% increase in power production efficiency**
 - ▶ **More dependable and reliable power by improved cyber security and adaptability**
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Questions?



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