

**PROPOSED PROCUREMENT AND EVALUATION  
PLAN FOR TYPE 1 OPTIMIZER**

## Definition, Original Device, Inventor

### Definition:

- ♦ Type 1 optimization refers to a method or equipment to conduct automatic index tests on Kaplan hydraulic turbines. The outputs are an optimum cam curve (blade to wicket gate relation) and an envelope of the optimum performance profile.

### Original Device:

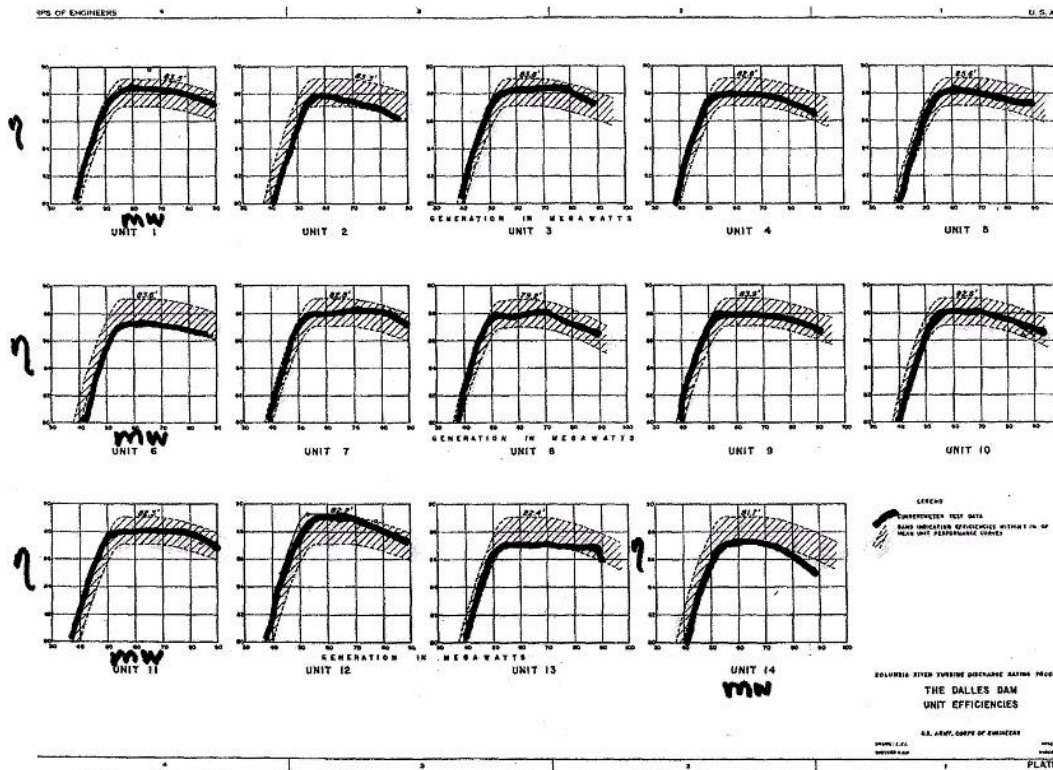
- ♦ Woodward Governor Company's Index Test Box (ITB). Patent has since expired.

### Inventor:

- ♦ Douglas Albright

TESTED By BPA and  
found acceptable years ago

# Why do we have to measure individual units curves?



The Dalles Performance Curves Units 1 thru 14

## Demonstration Project

A unit at the McNary powerhouse is proposed to be selected as the demonstration unit to evaluate the delivered Type 1 Optimizer. This project was selected for four reasons:

- ▲ This project has the new, electronic 3-D control units.
- ▲ McNary already has a GDACS system installed
- ▲ McNary is normally base loaded.
- ▲ The intakes of the generating units are equipped with fish screens.
- ♦ Extensive testing has already accurately determined the performance of certain units at this project.

— ~~best option~~ Best option is in mid B&G range  $\approx 22^\circ$   
16.8 32°

— may be able to extend 1% limit

## Technical Aspects of the Type 1 Optimizer

The manner in which this device uniquely indexes a Kaplan may be briefly described as follows:

- ♦ This optimizer utilizes the Winter-Kennedy piezometer system that is standard on Corps' Kaplan turbines to measure relative flow. These piezometers may be cleaned for use by back flushing without the necessity of unwatering the unit.
- ♦ Operations are not disrupted by use of this device.
- ♦ Device is housed in its own portable cabinet and has self contained instrument leads.
- ♦ It also uses the governor to keep a constant load on the unit. An electronic pressure differential transducer will measure the Winter-Kennedy piezometric differential. — may need research on hydraulic damping/calibration

## Technical Aspects of the Type 1 Optimizer (Continued)

- ▲ Then it perturbrates the blades about 3 percent of the blade servomotor stroke.
- ♦ Next, it readjusts the wicket gates to maintain constant power and then measures the relative efficiency. If efficiency has increased, it again moves the blades another 3 percent in the same direction, readjusts the gates to the same constant power value, and again measures efficiency. Once there is no further improvement in efficiency, it records that gate and blade relation as a point on the optimum cam curve.
- ♦ Each data point is carefully screened before it is recorded. Signal processing technology is used to ensure the stability and steadiness of all parameters before the measurement is recorded.
- ♦ Only one optimizer is needed at a powerhouse. A separate chip is used to record the data for each turbine-generator. In that manner, a historical performance record may be acquired on each individual unit.

♦ Can be incorporated into G DACS

## Product Output of Type 1 Optimizer

*A individual cam curves*

- ♦ Individual unit performance curves:
  - ◆ Without screens using direct measurements. *OR with screens*
  - ◆ With screens using offset cam curves (fish screens affect cam curves the same way as a head change).
- ♦ Individual performance curves will be used to construct discharge tables for installation into GDACS.
- ♦ New individual unit cam curves will be installed in the electronic control unit (governor).

*warning*

## **Contract Methodology**

- ♦ The Corps of Engineers will issue a Task Order contract to N-Link Corporation. The Task Order will contain a Work Scope, Schedule, and Budget; as well as name a Key Person.
- ♦ N-Link will either subcontract with Doug Albright or hire him as an N-Link employee.
- ♦ Deliverables will be a prototype, stand alone, demonstration unit as well as a complete source code listing.
- ♦ It will be a provision of the Task Order contract that the optimizer shall be capable of being integrated into the GDACS system with a minimal amount of modification.
- ♦ An option price on additional units will be negotiated as an item in the Task Order contract.
- ♦ The task Order contract will have a term of one year and provisions for price and time extensions.
- ♦ The government will retain a royalty free license to use the optimizer in any way desired.
- ♦ N-Link will negotiate any other commercial license provisions as an item of the Task Order contract.

## Work Scope of a Task Order to N-Link Corporation for the Procurement of a Type 1 Optimizer

This Task Order is issued to N-Link Corporation for the procurement of a Type 1 Optimizer. Type 1 optimization refers to the software and equipment to conduct automatic, unattended, index tests on Kaplan hydraulic turbines. An index test is a relative efficiency test performed to determine the shape of the optimum efficiency profile and the optimum cam curve to be input to the governor or control unit. A cam curve denotes the relation between the angle of the blades on the runner and the opening of the wicket gates, for a given head.

N-Link is to negotiate a contract with the inventor of a Type 1 Optimizer, originally referred to as an Index Test Box (ITB). The following stipulations are to be included in the procurement action:

- Deliverables:
  1. One prototype, stand alone, demonstration Type 1 Optimizer unit.
  2. A complete source code listing.
  3. A complete parts list.
  4. An instruction manual, which is to include installation and operation of the Type 1 Optimizer.
  5. Any required software and hardware to reduce and analyze the recorded test data.
  6. A data storage capability that will allow the historical compilation of performance data on each generating unit in a powerhouse.
- Patents:
  5. The Government is to be provided a royalty free license to use and replicate the resulting optimization technology in any way desired.
  6. The developer may retain any resulting patents and commercial licenses for non-governmental applications.
- Compatibility:
  7. The prototype Type 1 Optimizer is to be compatible with the control units on the turbine-generators at the McNary powerhouse.
  8. The Type 1 Optimizer is to be developed so that it is capable of being integrated into the GDACS system with a minimal amount of modification.
- Inputs and Outputs:
  9. It will be the developer's responsibility to access the type and quality of data inputs available at the project.
  10. The outputs of the Type 1 Optimizer are to be an efficiency profile and cam curve at specified intervals of head.
- Demonstration:
  11. The developer is to supervise the government's installation of the Type 1 Optimizer.
  12. After installation, the developer is to demonstrate the Type 1 Optimizer by having it conduct a complete index test at a single head and reduce and analyze the recorded test data to produce the specified outputs.
- Contract:

13. This procurement contract is to be negotiated only with the following and no others:

Douglas Albright  
Actuation Test Equipment, Incorporated  
3393 Eddie Road  
Winnebago, Illinois 60188  
Tel: (815) 335-1143  
E-mail: [DudleyDevices@AOL.com](mailto:DudleyDevices@AOL.com)

14. The procurement contract is to provide the government with an option of a negotiated per unit price for additional Type 1 Optimizers to be installed in other powerhouses.
15. Before signing and delivering, a draft of the negotiated procurement contract is to be submitted to the government for correction, comment and approval.