CHAPTER 10
INTEGRATED GENERATION SYSTEM

The integrated generation system combines operation of Dave Gates Generating Station with the Hydros and Thermals to jointly manage system operations. Exploring the potential value of an integrated system follows from NorthWestern's operating objectives of maintaining a high level of performance and identifying opportunities for improvement.

Background

The first step in the 2015 planning process, begun shortly after the Hydro transaction closed, was to examine how the fleet of hydroelectric, thermal, and intermittent wind resources could be used as a system to maximize economic and operational efficiency. In 2015, HDR Engineering, Inc. ("HDR") completed an enhanced operations capability study of the recently acquired hydroelectric facilities. The study provided information needed to create the foundation upon which the 2015 Plan is built. This plan seeks to leverage the capabilities and value of the Hydros beyond that set forth in the Hydros docket – establishing integrated operations for ancillary services and load following.

In prior plans, generation asset operations were generally segregated into two categories: 1) DGGS providing primarily regulation services and 2) all other generation (Basin Creek, Colstrip, Hydros, and PPAs) providing hourly energy and contingency reserves. The EOP in the 2015 Plan has the Hydros contributing approximately half of the necessary regulation services requirement with the balance supplied by DGGS. Basin Creek and Colstrip are also integrated into the resource optimization to enhance system economics, providing additional load following and contingency reserves. DGGS, in addition to regulation services, helps optimize the portfolio by providing peak demand capacity, flexibility, and other needed ancillary services.

DGGS, consisting of a series of 6 Pratt-Whitney FT8 combustion turbines (150 MW total), and three hydro resources, 1) Thompson Falls (94 MW), 2) Rainbow (60 MW) and 3) Mystic (12 MW), were pooled to jointly manage intra-hour system responses for regulation. The Hydros' relatively low operating cost coupled with the capability to rapidly cycle up and down are characteristics that enable them to perform multiple roles; however, they have estuary and physical system constraints that limit their abilities to assume more than about half of the system obligations for regulation and load following.

The integrated system further combines the thermal resources of Basin Creek (52 MW) and Colstrip (222 MW) to provide contingency reserves. The relative contribution of each resource toward regulation and contingency reserves is shown in Figure 10-1. The Hydros and DGGS nearly equally share the responsibility for regulation. For contingency reserves, about half is carried by DGGS and a third by Basin Creek with the balance provided by the Hydros.

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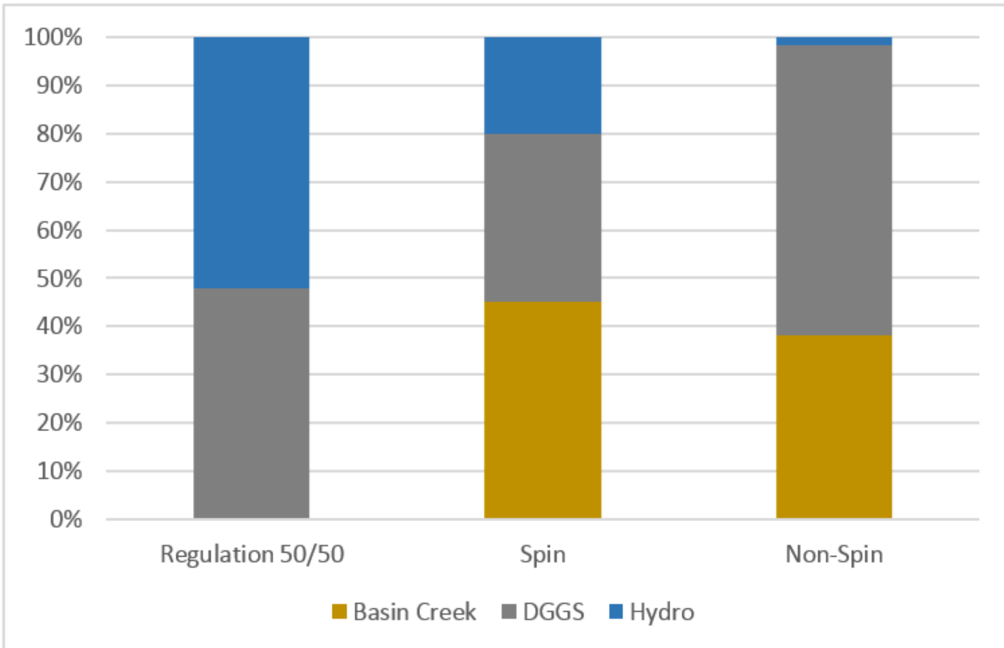
Figure 10-1 Integrated System Economic Sharing of Contingency Reserves and Regulating Requirements



Hydro Optimization

NorthWestern engaged the services of HDR in 2015 to perform a "Flexibility Operations Model Study" of the hydroelectric assets. This study represented the first phase of work to define the operational capabilities of the existing fleet and evaluate the possibilities of expanded operating roles. This work was accomplished using HDR's proprietary Computer Hydro Electric Operations and Planning Software ("CHEOPS") under conditions and constraints defined by project licenses, hydrologic conditions, and the physical characteristics of the hydroelectric fleet.

HDR customized the CHEOPS model for NorthWestern using historical operating and hydrological data from the projects comprising the Montana hydroelectric fleet. Natural groupings of projects were determined according to facility locations, major drainages, and the licenses under which they are operated. The three generalized groupings of the resources comprising the hydroelectric system are:

- Missouri – Madison Projects (including Canyon Ferry)
- Thompson Falls Project
- Mystic – West Rosebud Projects

HDR's modeling of the hydro assets included benchmarking of model performance to represent operational conditions and compared against historical values. CHEOPS uses facility specific system conditions and constraints including flow, reservoir elevations, equipment capability, storage, and operating criteria to calculate energy production across the different systems and for individual dams.

A simple overview of the HDR work is that they evaluated different "peaking scenarios" whereby different generating schedules could be used to produce at elevated and reduced levels of generation. The context of peaking for the purpose of evaluating flexibility is the amount and timing of available hydro generation to operate in a flexible rather than a run-of-river mode. HDR determined that peaking flexibility can be available and operationally consistent with FERC licenses.

Reservoir elevations and flow requirements are two metrics that must be properly managed according to FERC licensing requirements, operational requirements, and good utility resource management practices. The result of more flexible operation is a small reduction in total annual energy production. Reduced energy production occurs when reservoir levels are lowered, hydrologic head diminishes, and individual turbines operate at a lower point on their efficiency curves. A full presentation of the analytical approach, technical considerations, and results of the HDR work are presented in the "NorthWestern Energy

Hydro Fleet CHEOPS Model Operations/Verification Report (February 2015)" which can be found in Volume 2, Chapter 5.

HDR's analysis focused on operational effects, within existing operational constraints, and did not include the analysis of the economic benefits or costs associated with flexible operation and did not capture some of the more complex operational constraints. However, HDR's modeling served as the foundational analysis and initial conditions to support Ascend in the development of a more detailed model of co-optimized hydro and thermal operations. This analysis is presented in Chapter 12.