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Emergency Responses at Glen Canyon

This paper is intended to provide general understanding and guidance for emergency operations at Glen Canyon (GC) Power plant. GC is an integral part of the interconnected electric power system in the western United States, and serves a valuable role as a power supplier during system emergencies.

The Western Area Power Administration (Western), CRSP Management Center (MC), supplies power to customers from GC and other Federal hydroelectric power plants in the region. Generation schedules for the power plants are developed by the CRSP MC to meet anticipated customer loads and downstream water deliveries. Written operating criteria, equipment condition, and factors such as water and generator availability, environmental restrictions, and transmission system loading affect how much generation is available from each power plant. The Bureau of Reclamation (Reclamation) operates the power plants based on such operating conditions, schedules provided by the CRSP MC, and inputs from Western control computers located in Phoenix, AZ.

Western and Reclamation operate similarly to other power suppliers and electric utilities in the region by responding to system emergencies and share responsibility for maintaining a safe and reliable power system. The electric power system has become increasingly stressed due to increased electricity usage. Construction of power plants and transmission lines to serve the load has not kept pace. This power system stress is most apparent during the summer months. Transmission line loading approaches, or even exceeds, stable operating limits. Control Area reserve margins dwindle to nothing. These system conditions increase the likelihood of system emergencies that cause power outages, rolling blackouts, or brownouts.

Western and Reclamation must operate to meet WSCC and NERC operating criteria. For example, such criteria require system reserves and regulation with response to emergencies. If the CRSP MC repeatedly fails to meet the criteria, it can be fined and/or required to carry significantly larger amounts of reserves, thereby lowering the amount of generation that can be used to serve customer loads.

This paper describes several types of system emergencies and the ways that GC and other Federal hydroelectric units respond to them. In the event of a system emergency, GC and other Federal hydropower is used to the extent determined necessary to protect public safety and health. Western provides appropriate documentation for each emergency to Reclamation's Control Center at Page Arizona.

Frequency Excursions

The GC hydroelectric power plant is connected to the regional power grid, and its generating units are equipped with governors and computerized automatic generation controls that are designed to automatically vary generation levels to meet system load requirements while maintaining a system frequency of 60 Hz under normal circumstances.

Losing a major transmission line or generating unit on the interconnected system may cause a system emergency, changing the frequency of the power system due to the mismatch between generation to load. It can also cause other system problems such as high or low voltages and customer outages. During peak energy demand, emergencies or power system disturbances are much more likely to occur. Frequency excursions, although usually short in duration, can last up to a few hours. GC generation may be increased during these emergency periods such that water release levels could be exceeded over an integrated hourly amount.

System Restoration

GC generation may be called upon to assist with service restoration if localized or major power system disturbances cause widespread electric service disruptions. Since thermal generation requires significant time to regain pre-disturbance generation levels, quick-responding hydroelectric generation is critical for re-energizing transmission lines and restoring customer load.

Hydroelectric plants can reduce the duration of the outages by minutes or even hours because of their quick response. Hydroelectric generation can, in some cases, help keep a small, localized outage from turning into a major cascading system outage. GC could be called on to generate at high levels for several hours in the event of localized or major system disturbances to assure public safety and assist in restoring the interconnected system.

Reserve Group Responses

The CRSP MC belongs to two reserve-sharing groups, the Rocky Mountain Reserve Group (RMRG) and the Southwest Reserve Sharing Group (SRSG). Reserve-sharing groups operate on the concept that a group of electric utilities and power suppliers pool their reserves to provide coordinated response to emergency energy needs. This lets the reserve group members reduce the amount of reserve generation they would individually hold in reserve.

If a reserve group member were to lose a generating plant, the other reserve group members would each increase their generation by a pre-determined amount to replace the missing generation. The CRSP MC would ask Reclamation to increase generation

from generating units such as GC by their proportional share of the group response to the outage. The power supplier that lost the generation has up to 1 hour and 59 minutes (RMRG) or 1 hour (SRSG), (depending on at what point during the hour generation is lost) to replace the lost generation. The CRSP MC typically responds to Reserve Group outages several times a month, and could be called on to respond to emergencies in both Reserve Sharing Groups at the same time. The CRSP MC will use GC and other available hydro generation to meet its commitment to the Reserve Sharing Groups.

In all the cases outlined above, power plant operators and control area dispatchers have little or no warning that an emergency is about to happen. In the cases outlined below, operators and dispatchers usually have an hour or more of notice that a problem is occurring, and have more time to take preventative actions.

Inadequate Generation or Generation Outage Assistance

It has become common during the summer for all available generation from all power suppliers to be generating at or near maximum levels, leaving inadequate generation reserves. In these instances, utilities have little if any reserve generation to cover their own outages, and nothing to sell to others. Even capacity set aside by utilities for their Reserve Sharing Group requirements may be called into use to serve load.

Should a utility generating at or near maximum levels lose a large generator, or if its loads continue to increase beyond what it has forecasted, it has no recourse other than to shed load to avoid uncontrolled system breakup. During such an emergency, a utility will use all available generation reserves on their own system, and generation from the applicable Reserve Sharing Group in the case of a generation outage. It will shed non-critical, or interruptible load, and non-firm sales to other utilities. In many cases this load curtailment is sufficient to stabilize the system.

Where the danger of a system breakup is imminent even after all interruptible loads are curtailed, and all other generation sources available are maximized, the utility has no other choice but to implement a rolling blackout or brownout scheme in its service territory to maintain system integrity. GC and other available hydro generation may be called upon in this case to provide emergency energy to prevent blackouts and to prevent a total system collapse. GC generation may also be called upon as a way of counteracting transmission system congestion that is preventing generation from reaching load centers.

To request assistance under this scenario, the utility must be either directly interconnected with the CRSP transmission system, or be able to secure an adequate

wheeling path to the CRSP transmission system. The requesting utility will be required to declare that an emergency exists and will have exercised all reasonable alternatives before calling upon support from the CRSP MC. The utility will comply with the following conditions and subsequently document its claim of an emergency. To this end, all utilities that could be reasonably expected to require aid from the CRSP MC will provide a written statement agreeing to the criteria listed below. In this situation, the CRSP MC will request Reclamation to operate GC and/or other hydro power plants to supply necessary generation to the utility to fulfill their emergency needs. The utility will be charged the appropriate emergency outage rate for all such deliveries.

- The utility must have exhausted all reserve capacity, including its contribution to any Reserve Sharing Groups it belongs to,
- All non-firm energy sales must have been cut by the utility
- All interruptible loads under its control must have been cut,
- Capacity and energy must not be available from the interconnected system.
- In the case of a generating unit outage, Reserve Sharing Groups must have been activated and responding to the maximum extent possible,
- Previous requests for WSCC emergency outage assistance must have yielded an inadequate response,
- A blackout condition on their system is imminent,
- The transmission ties into the affected area must be able to support a generation energy schedule from GC.

An additional requirement for anyone requesting emergency assistance is that a maximum of 15,000 MWh of energy is available from Glen Canyon and/or other CRSP generation facilities. Hourly delivery amounts will be limited to surplus generation capacity available from CRSP facilities and transmission availability at the time of the emergency request. The energy will be made available through a rolling interchange account with an energy return ratio of 1.5 to 1, or other ratio as negotiated, to recover costs incurred. Entities receiving emergency assistance must return the energy back to CRSP within 1 week of delivery and within the month delivered (if possible) prior to receiving additional energy deliveries up to the maximum 15,000 MWh in total.

The 15,000 MWh of emergency assistance that Western and Reclamation are making available for emergency assistance is a pool of energy made available for use by all entities making requests in total. Once the pool of energy is utilized in total, the pool must be paid back prior to becoming available again, utilizing an accumulative rolling balance.

This restriction is necessary for Western and Reclamation to maintain water availability in the CRSP reservoir system to support firm electric service obligations and avoid

exposure to the surplus energy market.

Loss of CRSP MC Purchases

The CRSP MC purchases generation on an hour-by-hour basis to meet the needs of its firm electric service customers. These purchases allow available hydro generation to match customers changing load levels. Typically the CRSP MC purchases firming power during on-peak periods.

During low water years the CRSP MC may make longer-term firm purchases, or one-hour firm purchases to lock in larger quantities of power at lower prices. Should the selling utilities find themselves short on power, and be faced with blacking-out their native customer load, they may choose to cut their firm or one-hour firm deliveries to the CRSP MC and use that power to serve their customers instead. In any case, there is a risk of the supplier not having the ability to deliver the power due to transmission outages or overload conditions.

If one or more of the CRSP MC power purchases were to be withdrawn, and no other CRSP MC resources are available, it may become necessary to increase generation at GC or other available hydro power plants. Generation would be increased until another source of power could be secured, or until loads drop in the evening.

Endnotes