



## **Adopted by the Northwest Power Pool Operating Committee for Underfrequency Load Shedding and Restoration Program 2008-2009**

As a continuance to the NWPP Operating Committee charge to the NWPP Corporation dated January 2007 OC, this work is to review and assess the current program for off-peak summer operations. Based on the final 2008 assessment, the load shed plan being implemented by the NWPP membership is deemed to be compliant with the WECC regional Off-Nominal Frequency Program. Although not identical, the NWPP plan is designed to shed load for each required block such as to meet the required load reduction as defined by the regional Coordinated Plan. All other features in the WECC Off-Nominal Frequency Program are accepted as written, to be applied and implemented in the NWPP Underfrequency Load Shedding and Restoration Program.

A mitigation plan may be required to address the 3% difference in the NWPP Plan as compared to the regional Coordinated Plan. Augmentation may be to add an earlier block at a higher frequency similar to the WECC SW members using 59.5Hz to correct a few small resource loss events that do not result in a frequency excursion below 59.3Hz. If not added then change the five load-shed blocks's per cent from 5.6% to 6.2%, totaling 31% of the required 31.1% value for NERC compliancy. This may be moot, since WECC's task force accepted the present plan.

For limited impact to the membership, the assumptions regarding the unique design parameters needed to have flexibility for implementation. It has been noted not all members followed the plan to the exact frequency and Load Shed per cent. However applied by members, the technical study results are acceptable in rebalancing and securing the NWPP operating region following an off-nominal frequency event. This plan has been successfully tested on several known system configurations inside the NWPP region. Results of the North Island assessment using the implemented relay data indicated the plan will arrest the frequency excursion and provide an adequate recovery to 59.4Hz, just below the continuous operating region (59.5Hz to 60.5Hz) for the system generation. The twenty second simulations are suggesting the anti-stall feature will be exercised at the high resource loss levels. At these high resource loss levels, the anti-stall elements appear to have limited impact on the continued frequency recovery position and may need to be augmented to a higher load shed levels. This may need to be addressed by the regional plan as authored by WECC.

The wind impact on the implemented program was also assessed in 2008. Based on the observed wind output for members it can be stated the observed wind generation off-set does not impact the effectiveness of this operating program. However planning work which will focus on higher wind output will show a diminishing effect on the regional UFLS program. Assumptions of high to maximum wind output will stall the planning models. This diminished performance in planning reviews suggests the variable wind assumptions need to be refined for assessments of extreme events to include reserves levels.

Members must be able to provide when request and within the required time, complete evidence for detailing and all necessary documentation of these features, with emphasis on Frequency, time for action, and armed real power (MW). This implemented relay data includes association to, and reference to, the regional operating steady state and dynamic models for assessment work. Templates have been developed and are in place allowing for reporting which completes the assessment with annual documentation of armed load.



**The NWPP Enhance UFLS Plan**

**Off-Nominal Frequency Turbine Generator Protection**

This feature follows the WECC plan as written. No other augmentation is being deemed required at this time. The following frequencies and time specifications are required:

<b>Underfrequency Limit</b>	<b>Overfrequency Limit</b>	<b>Maximum Time</b>
60.0 - 59.4Hz	60.0 – 60.5Hz	N/A
59.4 – 58.5Hz	60.6 – 61.5Hz	3 minutes
58.4 – 57.9Hz	61.6 – 61.7Hz	30 seconds
57.8 – 57.4Hz		7.5 seconds
57.3 – 56.9Hz		45 cycles
56.8 – 56.5Hz		7.2 cycles
56.4 – below	61.7 – greater	instantaneous trip

Generators not meeting these set requirements must automatically trip load to match the anticipated generation loss at the same comparable frequency level generation is tripped. On request Generator Operator will provide evidence of relay protection for each operating unit to note trip frequency, time to trip, and include reset frequency.

**Off-Nominal Load Shed and Restoration blocks**

This is based on shifts defined in the 1998-1999 report to the NWPP OC members. This enhanced plan utilized five equal blocks of 5.6% load shedding. The overall goal of this feature is to drop 28% of the 30% regional requirement. NWPP plan meets the cumulative load shed per cent for events excursions hitting 58.5Hz and has a 0.0% error between these two documented programs, provided the member used the exact values. WECC Off-Nominal Task Force accepted this approach in 1999 based on the inclusion of the NWPP use of the DSI Direct Load Trip feature. This plan, as implemented, has the NWPP members having 0.0% error at 58.5Hz and staying within 3% cumulative error of the regional plan at the 58.3Hz block. The following set points define the present plan and note the error according to the disclosed 1997 WECC regional Coordinated Plan:

<b>Block#</b>	<b>Hertz</b>	<b>NWPP Cumulative</b>		<b>WECC Cumulative</b>			<b>NWPP Error%</b>
		<b>Block%</b>	<b>Load%</b>	<b>Hertz</b>	<b>Block%</b>	<b>Load%</b>	
Block 1	59.3Hz	5.6%	5.6%				0%
Block 2	59.2Hz	5.6%	11.2%				0%
				59.1Hz	5.3%	5.3%	0%
Block 3	59.0Hz	5.6%	16.8%				0%
				58.9Hz	5.9%	11.2%	0%
Block 4	58.8Hz	5.6%	22.4%				0%
				58.7Hz	6.5%	17.5%	0%
Block 5	58.6Hz	5.6%	<b>28.0%</b>				<b>0%</b>
				58.5Hz	6.7%	24.2%	<b>0%</b>
				58.3Hz	6.7%	<b>31.1%</b>	<b>3.1%</b>

**Anti-stalling using automatic load shedding per WECC plan**



<b>Block#</b>	<b>Hertz</b>	<b>Block%</b>	<b>Time</b>
Block 1	59.3Hz	2.3%	15 seconds
Block 2	59.5Hz	1.7%	30 seconds
Block 3	59.5Hz	2.0%	60 seconds

**Overshoot Protection using automatic load restoration per WECC plan**

<b>Block#</b>	<b>Hertz</b>	<b>Block%</b>	<b>Time</b>
Block 1	60.5Hz	1.1%	30 seconds
Block 2	60.7Hz	1.7%	5 seconds
Block 3	60.9Hz	2.3%	0.25 seconds

**Load trip time**

The relay and breaker total trip time shall be no more than 14 cycles at the indicated frequency set points.

**Additional frequency set points utilization**

Additional frequency set points can be used provided the cumulative total load shed amount meets the requirements of the regional plan for each of the plan’s frequency set point.

**Compliance assessment for plan differences**

Members are responsible for conducting studies for shifts or differences in their plan such as to verify compliance with both the NWPP and the regional Coordinated Plan. These studies shall be deemed evidence and provided to, and reviewed by, both the NWPP Underfrequency Work Group and the WECC Underfrequency Implementation Task Force for acceptance and compliance.

**Load Restoration**

As defined in the Off-Nominal Frequency plan, members who elect to restore load via automatic scheme will have armed only three blocks of approximately 2% each. No manual load restoration will be allowed until the system has been normalized. In any event, automatic load restoration shall begin no sooner than 30 minutes after the frequency has been restored to 59.95Hz and no faster than 2% per five minutes. All load restored manually shall be under the directions of system dispatchers and follow these requirements.

1. Frequency has to be stabilized at or above the 59.8Hz prior to starting restoration.
2. Load shall be restored in steps no greater than one-third of the block tripped.
3. Load restoration shall be delayed to one step per minute.
4. Load shall not be restored until adequate generation is available to carry the load.
5. All associated transmission facilities will be restored and deemed operational prior to restoring impacted load.

**Relay classification and types**

All associated frequency relays shall be Solid State and/or Microprocessor (SSM) when determining compliance to the UFLS Plan. Only load tripped by SSM relays will be considered when determining compliance to the UFLS Plan. Generator protection schemes shall utilize SSM relays in the range of 57.9 to 61.0Hz. Electro-mechanical frequency relays can be used for any setting outside the 57.9 to 61.0 Hertz range. Dual nature (Frequency and Voltage input) relays



**shall not** be disabled for voltages 80% of nominal or higher but can be disabled for voltage below 80% of nominal, at the discretion of the setting entity.

**Overvoltage Protection**

Systems shall implement automatic measures to maintain operating voltages within acceptable limits following an underfrequency load shedding event.

**Direct Load Trip**

Associated systems can utilize direct load trip if it complements the implemented UFLS plan and does not cause issues with the MORC standards or the coordination between adjacent BA's.

**Security Coordinator guide**

If existing, members shall follow the security coordination guide for load restoration following an underfrequency load shed event.