Chapter 2

EXISTING LOAD SHEDDING SCHEME

2.1 Load Shedding Scheme

In the Power System, regular changes in the system load are handled by the frequency controlling machine. In Sri Lankan network Victoria, Kotmale, New Laxapana and Samanalawewa are the frequency controlling machines [2]. In generally frequency declines due to generator deficiency is governed by the combined action of Spinning reserve and frequency controlling machine. But in the event of rapid frequency decline, governor of the frequency controlling machine has no time to response quickly. So it is necessary to intentionally and automatically disconnect a portion of the load equal to or greater than the overload. After the decline has been arrested and the frequency returns to normal, the load may be restored in small increments, allowing the spinning reserve to become active and any additional available generators to be brought on line.

Frequency is a reliable indicator of an overload condition (at a particular time, load on the system is grater then the Generating capacity) [12]. Frequency sensitive relays which use Voltage Transformer input to recognize the frequency can therefore be used to disconnect load automatically. Such an arrangement is referred to as a load shedding scheme and is designed to reserve system integrity and minimize outages. Although utilities generally avoid intentionally interrupting service, it is sometimes necessary to do so in order to avoid major system collapse. In general, noncritical loads, usually residential, can be interrupted for short periods, minimizing the impact of the disturbance on service.

Automatic load shedding, based on under frequency is necessary since sudden, moderate to severe overloads can drive a system into a hazardous state much faster than System operator can react. Under frequency relays are usually installed at distribution substations, where selected loads can be disconnected.

The object of load shedding is to balance load and generation. Since the amount of overload is not readily measured at the instant of a disturbance, the load is shed a block at a

time, each controlling its own block of load and each set to a successively lower frequency. The first line of frequency relays is set just below the normal operating frequency range. When the frequency drops below this level, these relays will drop a significant percentage of system loads. It this load drop is sufficient, the frequency will stabilize or actually increase again. If this first load drop is not sufficient, the frequency will continue to drop, but at a slower rate, until the frequency range of the second line of relays is reached. At this point, a second block of load is shed. This process will continue until the overload is relieved or all the frequency relays have operated. An alternative scheme is to set a number of relays at the same frequency or close frequencies and use different tripping time delays [1].

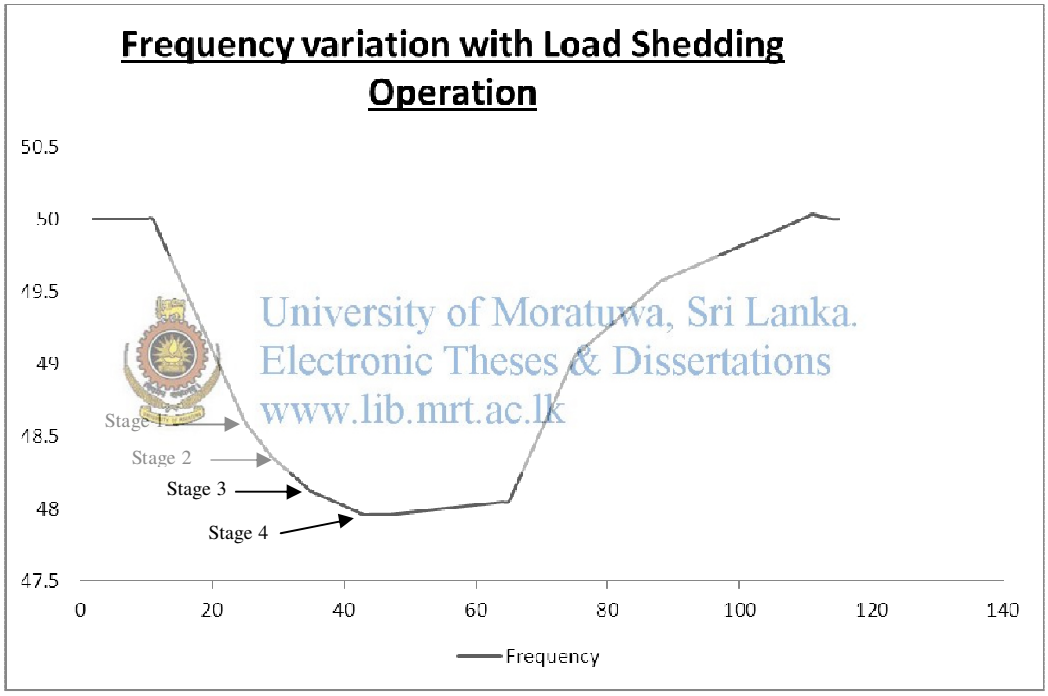

Figure 2.1 – System Frequency variation with the Load Shedding operation.

2.2 Existing Load Shedding Scheme

Table 2.1 – Existing Load Shedding Scheme

Stage	Load to be Tripped (%)	Remarks	Tripping Criteria
I	5	5% Load on only freq. based	48.75 Hz + t=100 ms
II	5	5% Load on only freq. based	48.50 Hz + t=500 ms
III	10	7% Load on only freq. based	48.25 Hz + t=1 s OR
		3% Load on only freq. based + df/dt based	49 Hz AND df/ft = 0.85 Hz/Sec
IV	10	7% Load on only freq. based	48.00 Hz + t=1.5 s OR
		3% Load on only freq. based + df/dt based	49 Hz AND df/ft = 0.85 Hz/Sec
V	10	6% Load on only freq. based	47.50 Hz + t=inst OR
		4% Load on only freq. based + df/dt based	49 Hz AND df/ft = 0.85 Hz/Sec
VI	10	10% Load on df/dt based	49 Hz AND df/ft = 0.85 Hz/Sec

The Existing Load Shedding Scheme is shown in Table 2.1, as per the scheme there are six Load Shedding stages where first two stages reject 5% of the load each and other stages reject 10% of the load each. So if all six stages operate 50% of the system load will be rejected (Half of the system). It is like 30% of load base on Under Frequency which start when frequency goes below 48.75 Hz and rest of the 20% of the load is based on the rate of change of frequency. Load rejection amount during Off Peak, Day Peak and Night Peak can be found in Table 2.2

Table 2.2 – MW Rejection from Existing Load Shedding Scheme

	Off Peak		Day Peak		Night Peak	
	MW	% from System Load	MW	% from System Load	MW	% from System Load
Stage 1	42.85	5.53	78.5	5.6	90.25	5.01
Stage 2	41.5	5.35	67.25	4.8	88.7	4.92
Stage 3	83.65	10.79	126.4	9.02	154.25	8.56
Stage 4	60.39	7.79	127.2	9.07	149.72	8.31
Stage 5	75.05	9.68	125.92	8.98	154.95	8.6
Stage 6	81.21	10.48	151.69	10.82	159.13	8.83
Total	384.7	49.62	676.96	48.29	797	44.23

2.3 System Response to the System Disturbances.

Below shows the System Response to the system disturbance with existing load shedding scheme.

2.3.1 Tripping of Norochcholai coal Power Plant

On 07th of June 2011 at 12.17 PM, Norochcholai coal Power Plant tripped [3]. Due to tripping 240 MW rejected from the system and four stages of the Load Shedding Scheme were operated rejecting 40% of the loads. Minimum frequency was 47.601 Hz and rate of change of frequency (df/dt) is -0.743 Hz/Sec.

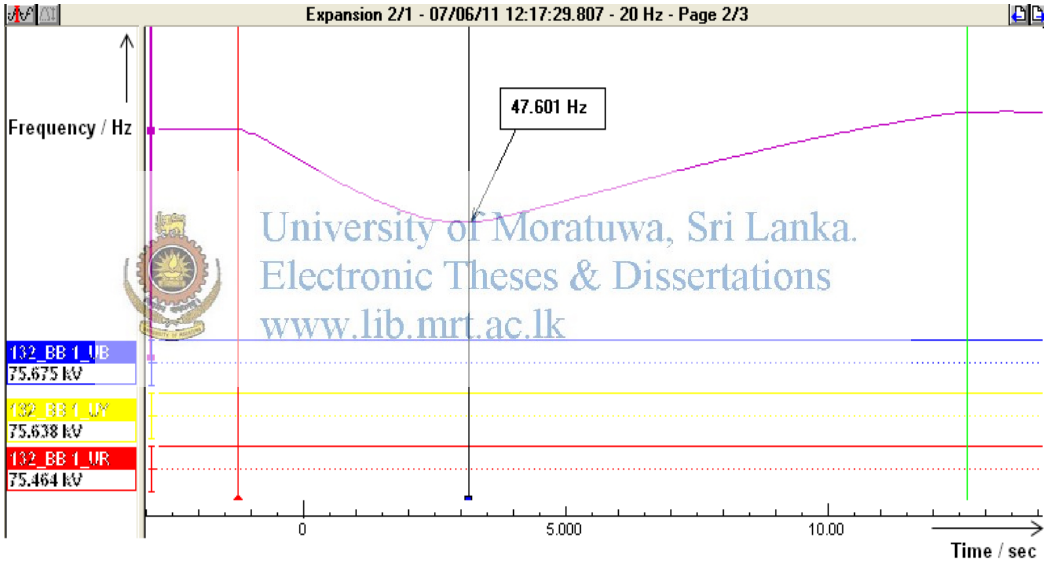

Figure 2.2 – System Frequency variation on 07th of June 2011 at 12.17 PM.

2.3.2 Tripping of Kerawalapitiya Power Plant

On 27th of July 2011 at 09.17 AM, Kerawalapitiya Power Plant tripped [3]. Due to tripping 137 MW rejected from the system and two stages of the Load Shedding Scheme were operated rejecting 10% of the loads. Minimum frequency was 48.499 Hz and rate of change of frequency (df/dt) is -0.046 Hz/Sec.

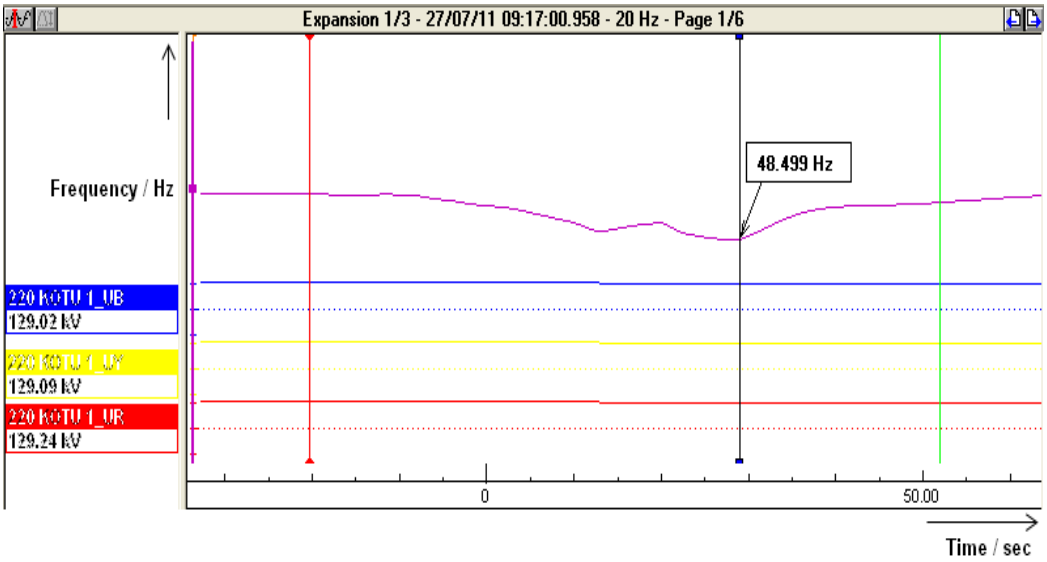

Figure 2.3 – System Frequency variation on 27th of July 2011 at 09.17 AM

2.4 Analyze of Existing Load Shedding Scheme

Existing Load Shedding Scheme is analyzed with the simulations and identified the best settings for Load Shedding and hence proposes a new Load Shedding scheme for Sri Lankan Network.