Q. Provide a copy of the most recent LOLH study and a copy of the study submitted in the 2001 GRA.

A. The attached report "An Analysis to Determine The Relationship Between Load Factor And System Reserve Requirement", April 2001 was prepared in response to a Board recommendation to study the number of peaks upon which the CP allocator for generation demand costs should be based. That issue was addressed at Hydro's 2001 GRA and the report has therefore not been updated.

An Analysis to Determine
The Relationship Between Load Factor
And System Reserve Requirement

Newfoundland and Labrador Hydro

System Planning Department

April 2001

Executive Summary

Following the 1992 referral by Newfoundland & Labrador Hydro (Hydro) on the proposed cost of service methodology and proposed rate stabilization plan adjustment, the Public Utilities Board (PUB) issued a report that a 1 CP cost allocator be approved for interim use in the Island Interconnected System. The report stated that Hydro present to the PUB at the time of its next rate hearing, an analysis of the relationship between load factor and system reserve requirement, together with a recommendation regarding the number of peaks on which the CP allocator for generation demand costs should be used.

This report describes the analysis undertaken to respond to the PUB's request.

As expected, the results of the analysis confirm that, in order to maintain Hydro's reliability criteria for capacity, as system load factor increases there is a need for greater system reserve capacity, and vice versa.

The analysis also indicates that the greatest LOLH contributions are made in the peak month of February (65% contribution at 60% annual load factor) and followed by January (21% contribution at 60% annual load factor). As the annual load factor increases, the portion of the LOLH contributions for January and February combined increases from 71% at a 50% annual load factor, to 96% at a 70% annual load factor. The contribution from the remaining months is a relatively minor portion of the annual LOLH.

It is therefore recommended that the allocation of generation demand costs should be based on the CP's of the two peak months (i.e. a 2 CP cost allocator).

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1. Introduction

Following the 1992 referral by Hydro on the proposed cost of service methodology and proposed rate stabilization adjustment, the Public Utilities Board's February 1993 report to the Minister of Mines and Energy recommended the following as Item No. 8:

> *That a 1 CP cost allocator be approved for interim use in the Island Interconnected System and that Hydro present to the Board at the time of its next rate hearing an analysis of the relationship between load factor and system reserve requirement, together with a recommendation regarding the number of peaks on which the CP allocator for generation demand costs should be used.*

This report describes the procedure followed to address the PUB's recommendation and presents the results of the analysis.

2. Methodology

The method used to address the PUB's recommendation is to compare both the monthly contributions to the annual LOLH, and the system reserve requirements over a range of load factors. Based on the amount of installed capacity planned for 2002, an annual peak load is chosen large enough to evaluate the range of load factors. For each load factor evaluated, sufficient peaking capacity is added to the system to result in an annual LOLH expectation equivalent to Hydro's capacity planning target. The required information is then drawn from the system simulations.

In order to perform this analysis, the following information is required:

- A description of existing and planned system capacity;
- A representative shape of the system load; and
- Capacity planning criteria.

Each of these items is discussed in further detail in the following sections.

2.1. System Capability

Table 2-1 provides a summary of the existing capacity and energy capability of the Island System. Hydro is the prime supplier of electrical energy, accounting for 81% of the Island's net capacity. The remaining capacity is supplied by Newfoundland Power Inc. Limited (8%), Corner Brook Pulp and Paper Limited (6%) and Abitibi Consolidated Inc. (3%). Hydro also has contracts with two small hydro non-utility generators (1%) for the supply of energy.

Hydroelectric generating units account for 64% of the total existing Island net capacity and firm energy capability. The remaining net capacity comes from thermal resources on the Island and is made up of conventional steam, combustion turbine and diesel generating plants. Approximately 70% of the existing thermal capacity is located at the Holyrood Thermal Plant and is fired using heavy oil. The remaining capacity is located at sites throughout the Island and is fired on light oil.

In addition to this existing capacity, Corner Brook Pulp and Paper will be continuing the program to upgrade the 60 Hz units at Deer Lake with five of the seven units completed by 2002.

Table 2-1

Island Capability			
	Net Capacity (MW)	Energy (GWh)	
		Firm	Average
Newfoundland & Labrador Hydro			
Bay D'Espoir	592.0	2234	2598
Upper Salmon	84.0	476	552
Hinds Lake	75.0	283	340
Cat Arm	127.0	605	735
Paradise River	8.0	27	39
Snook's, Venam's & Roddickton Mini Hydros	1.4	5	7
TOTAL HYDRO	887.4	3630	4271
Holyrood	465.5	2996	2996
Combustion Turbine	118.0	-	-
Hawke's Bay & St. Anthony Diesel	14.7	-	-
TOTAL THERMAL	598.2	2996	2996
Newfoundland Power Inc.			
Hydro	93.2	323	439
Combustion Turbine	47.2	-	-
Diesel	7.0	-	-
TOTAL	147.4	323	439
Corner Brook Pulp and Paper Ltd.			
Hydro	121.4	781	860
Abitibi Consolidated Inc.			
Hydro	58.5	443	470
Non-Utility Generators			
Hydro	19.0	107	146
TOTAL EXISTING + COMMITTED (JAN 2002)	**1831.9**	**8280**	**9182**

2.2. Load Shape

This analysis uses actual load data from years 1990 to 1994. This data has been normalized to produce a load shape considered to be representative of the Island Interconnected System load and has an annual load factor of 59%. To analyze the effect of changing load factors it is necessary to adjust the load shape to place more or less energy under the curve while maintaining a constant peak load. This adjustment is accomplished through the Load Forecast Adjustment (LFA) module of STRATEGIST™, the generation planning tool used by Hydro. STRATEGIST™ is an integrated strategic planning system consisting of several interrelated modules. It performs, among other things, generation system reliability analysis, production costing simulation and generation expansion planning analysis. The LFA module, which is pertinent to this portion of the analysis, modifies the shape by adjusting the load in the shoulder hours thereby maintaining the load peaks and valleys.

2.3. Planning Criteria

NLH has established criteria related to the appropriate reliability, at the generation level, for the total Island System which sets the timing of generation source additions. These criteria set the minimum level of reserve capacity and energy installed in the System to insure an adequate supply for firm load:

Energy

The Island Interconnected System should have sufficient generating capability to supply all of its firm energy requirements with firm System capability.

Capacity

The Island Interconnected System should have sufficient generating capacity to satisfy a Loss of Load Hours (LOLH) expectation target of not more that 2.8 hours per year.

3. Analysis and Results

In order to analyze the effect of a change in load factor, it was necessary to set a peak load sufficient to require some capacity addition to the existing system in order to achieve the reliability criterion of 2.80 hours/year at a 50% annual load factor, the lowest load factor considered in this study. A peak load of 1,700 MW was chosen to satisfy this condition and resulted in the required addition of 40 MW of combustion turbine peaking capacity for the 50% annual load factor case.

Table 1 shows the relationship between annual load factor and LOLH contribution in each month. The table shows that the greatest LOLH contributions are made in the months of February (65% contribution at 60% annual load factor) and January (21% contribution at 60% annual load factor). As the annual load factor increases, the portion of the LOLH contributions for January and February combined increases from 71% at a 50% annual load factor, to 96% at a 70% annual load factor with the greatest variation seen in February.

The LOLH contributions of the off-peak months of April through November are practically zero, with the months of March and December making up the balance from the higher contribution months.

Figure 1 presents a graphical representation of the Table 1 results and shows the variations in the monthly contributions to annual LOLH.

Contributions to LOLH are affected by the scheduling of thermal capacity for maintenance. STRATEGIST™ schedules the maintenance of thermal units, starting with the units that have the largest impact on system reliability, into periods which result in the least impact on LOLH. The relationship between load factor and percent reserve in each month, with system capacity adjusted for the amount of generation undergoing maintenance, is presented in Table 2

and graphically in Figure 2. The months May through October have the highest percent reserve and are when thermal capacity maintenance occurs.

4. Conclusions

As expected, the results of this analysis confirm that, in order to maintain Hydro's reliability criteria for capacity, as system load factor increases there is a need for greater system reserve capacity, and vice versa.

The analysis also indicates that the greatest LOLH contributions are made in the peak month of February (65% contribution at 60% annual load factor) and followed by January (21% contribution at 60% annual load factor). As the annual load factor increases, the portion of the LOLH contributions for January and February combined increases from 71% at a 50% annual load factor, to 96% at a 70% annual load factor. The contribution from the remaining months is a relatively minor portion of the annual LOLH.

It is therefore recommended that the allocation of generation demand costs should be based on the CP's of the two peak months (i.e. a 2 CP cost allocator).

Appendix A

Table 1

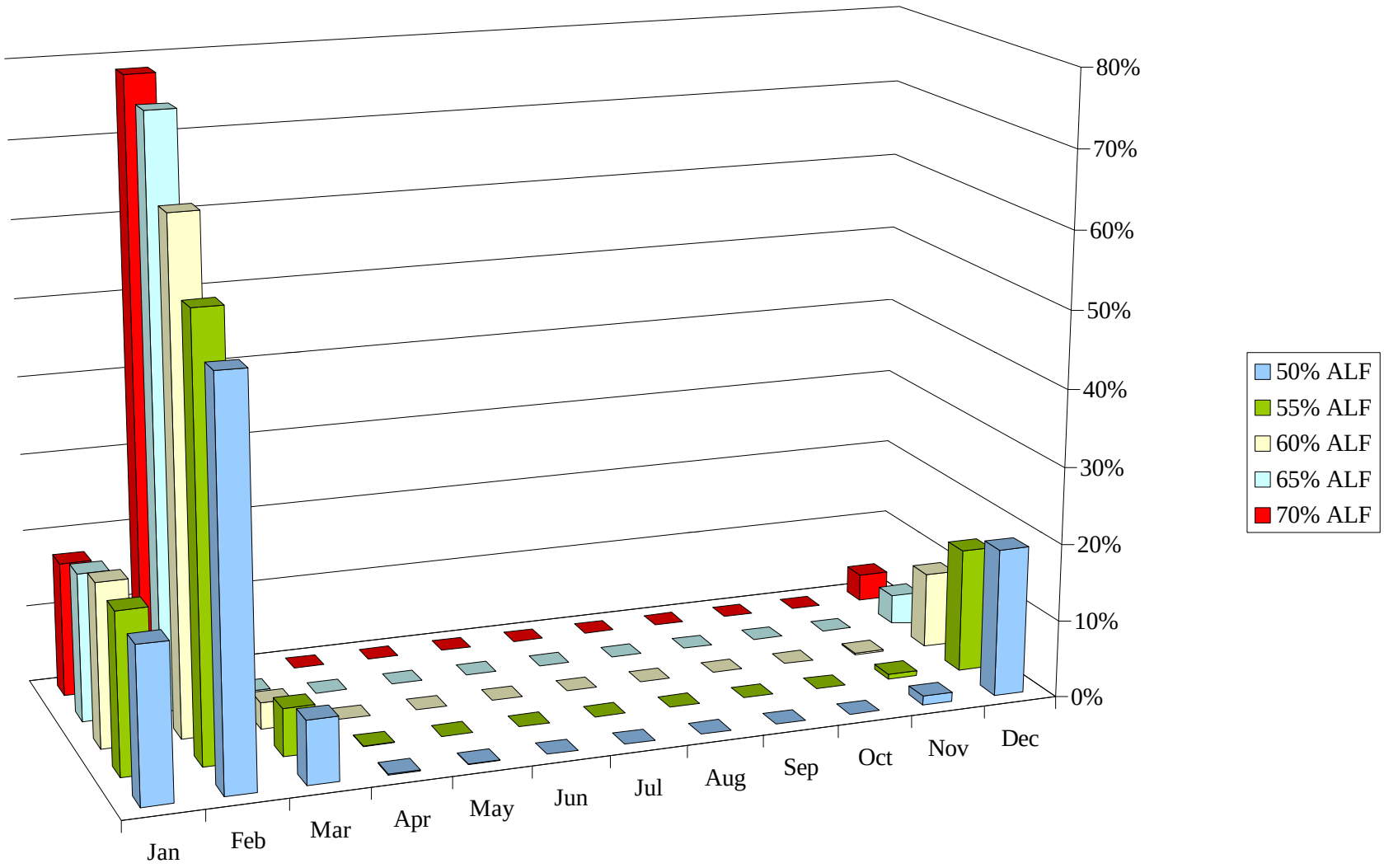
LOLH Analysis to Determine the Appropriate Number of CP Demand Allocators

Load Factor and LOLH Contributions in Each Month

Annual Peak (MW)	Load Factor %	LOLH (hours/year)	LOLH Contribution in each Month (hours/year and % of annual)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1700	50	2.80311	0.55902 19.9%	1.43777 51.3%	0.23027 8.2%	0.00417 0.1%	0.00188 0.1%	0.00014 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00041 0.0%	0.03256 1.2%	0.53689 19.2%
1700	55	2.80308	0.58236 20.8%	1.57744 56.3%	0.17231 6.1%	0.00180 0.1%	0.00063 0.0%	0.00003 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00012 0.0%	0.01849 0.7%	0.44989 16.0%
1700	60	2.80224	0.59191 21.1%	1.83356 65.4%	0.09604 3.4%	0.00030 0.0%	0.00005 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00552 0.2%	0.27485 9.8%
1700	65	2.80352	0.53696 19.2%	2.12371 75.8%	0.03736 1.3%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00042 0.0%	0.10507 3.7%
1700	70	2.80294	0.48710 17.4%	2.19816 78.4%	0.01795 0.6%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00000 0.0%	0.00005 0.0%	0.09968 3.6%

Figure 1

Load Factor vs. Monthly Contributions to LOLH



Newfoundland and Labrador Hydro
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April 2001

Table 2

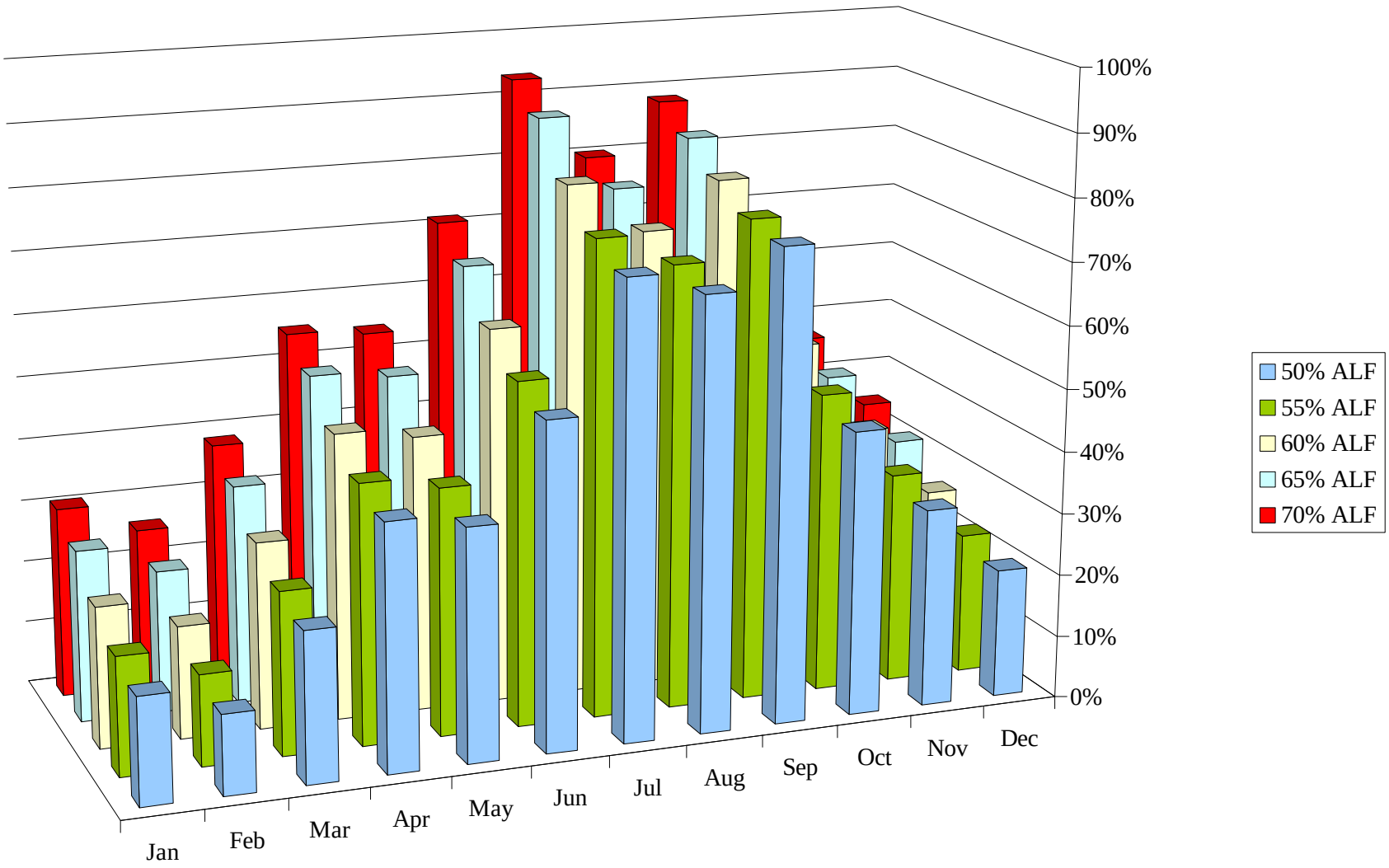
LOLH Analysis to Determine Appropriate Number of CP Demand Allocators

Load Factor and Percent Reserve

Annual Peak (MW)	Load Factor %	Units Added	Annual Percent Reserve	Percent Reserve in each Month											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1700	50	40 MW	13%	17%	13%	24%	39%	37%	52%	73%	69%	75%	45%	32%	21%
1700	55	1 x 50 MW + 21.6 MW	15%	19%	15%	26%	42%	39%	55%	76%	71%	77%	48%	34%	23%
1700	60	2 x 50 MW + 30 MW	18%	23%	18%	30%	46%	44%	60%	81%	73%	80%	53%	38%	26%
1700	65	4 x 50 MW + 11.6 MW	23%	28%	23%	35%	52%	50%	67%	90%	77%	85%	60%	43%	31%
1700	70	5 x 50 MW + 11.4 MW	26%	31%	26%	38%	55%	54%	71%	93%	80%	88%	64%	47%	34%

Figure 2

Load Factor vs. Monthly Percent Reserve



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