

# **Non-Physical Loss Handling**

A Market Clearing Engine Study of the NEMS

By Lu Feiyu Senior Market Analyst

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## About the Author

#### Lu Feiyu, Senior Market Analyst

Lu Feiyu joined Energy Market Company, the market operator for the National Electricity Market of Singapore, as a Market Analyst in March 2002. His primary responsibilities are the daily operation of the market and review of its outcome, dissemination of market information and inhouse application development. Feiyu is also one of the company's pioneers in conducting local and international training and educational forums about the market clearing engine, specifically its formulations, pricing methodology and system enhancements. He is actively involved in enhancing the market system by identifying gaps between business processes and the market system, suggesting improvements and preparing and performing user acceptance tests. He also contributes to the market rule change process through technical reviews of the proposed changes.

Feiyu holds a Bachelor degree in Electrical Engineering from Tianjin University (China) and a Master of Engineering degree in Electrical and Electronic Engineering from Nanyang Technological University (Singapore).



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## 1.0 Introduction

This paper studies the reasons for non-physical loss handling in the National Electricity Market of Singapore (NEMS) and focuses on the instances where it is triggered by a negative marginal offer price. It describes how the NEMS approximates the quadratic loss function using a model of the transmission circuit with nine constant nodes and eight linear segments and follows the solution step by step. A case study of an actual negative price case on 6 October 2003 is included.



## 2.0 Non-Physical Loss in the MCE

#### 2.1 What is non-physical loss?

The objective function of the linear programme (LP) solver in the NEMS is to maximise the social welfare of dispatching energy, reserve and regulation over the Singapore power system. To simplify the analysis, only energy is considered. The objective function effectively becomes:

Maximise ( $\Sigma$ PurchaseBidPrice×PurchaseBlock –  $\Sigma$ GenerationOfferPrice×GenerationBlock)

The PurchaseBidPrice is fixed at \$50,000/MWh, and the  $\Sigma$ PurchaseBlock is equal to the system load forecast. Therefore, for a given period, both are constant values. Hence, the GenerationOfferPrice and the GenerationBlock become the determinant factors.

The number of GenerationBlock dispatched is a function of the total generation of the NEMS. The higher the generation, the greater the number of GenerationBlock are dispatched and, subsequently, the higher the offer price that is cleared. As the generation comprises the load forecast and the transmission loss, the solver will, in most cases, attempt to minimise the losses on the branches and, hence, minimise the total number of GenerationBlock dispatched and maximise the total objective function value.

However, an anomaly may occur when the marginal offer price is negative. In order to maximise the total objective function, the solver will attempt to maximise the generation. As such, the solver will select the largest possible loss it can incur; in the case of the NEMS, non-adjacent nodes will be selected to produce a larger-than-normal loss for a certain flow. This anomaly is referred to as non-physical loss (NPL) and, if left unresolved, would result in considerable errors in the calculation of transmission loss and of energy dispatch during negative prices.

Theoretically, when the marginal price is zero, NPL may also appear because over-dispatch does not impact the objective function value when the nodal prices are zero throughout the system. Another possible occurrence of NPL is in tandem with the spring-washer effect, where any extra MW incurred from NPL enables more flow on the parallel paths. If the cost of NPL is less than the benefit gained from the additional flow, the solver will choose NPL. This more complicated scenario requires a separate discussion and is not covered in this paper.

#### 2.2 What is the NPL problem in the MCE?

Different market models employ different methodologies to handle NPL, based on the specific market design, and especially on the transmission circuit modelling. For example, in Australia, National Electricity Market Management Company (NEMMCO) employs NPL Run in which the multi-segment interconnector loss model for each interconnector is effectively removed and replaced with a static loss factor; and the interconnector flow targets are clamped to within ±250MW of their initial interconnector flows to prevent actual losses from deviating too greatly from those determined using the static loss factor.

The NEMS takes a different approach. The market clearing engine (MCE) models the transmission circuit using nine constant nodes and eight linear segments. Thus the quadratic loss function (Loss = Resistance \* Flow ^ 2) is approximated by a series of linear segments, as depicted in the figure:





The mathematical expression for the above model is:

$$LineFlow_{k} = \sum_{j \in DISCRSUB_{k}} LineFlowConst_{k,j} \times Weight_{k,j} \\ + DeficitWLineFlow_{k} - ExcessWLineFlow_{k}$$

$$LineLoss_{k} = \sum_{j \in DISCRSUB_{k}} LineLossConst_{k,j} \times Weight_{k,j}$$

$$\sum_{j \in DISCRSUB_{k}} Weight_{k,j} = 1$$

 $\{k \in LINES, k \notin ARTIFICIALLINES1 \cup ARTIFICIALLINES3\}$ 

A new variable, Weight, is introduced to compose the best solution by combing through the nine variables of each of the constant nodes to find the best two nodes for each solution.

Under a positive nodal price scenario, the solver always uses the two adjacent nodes surrounding a certain flow to drive the transmission loss on a circuit. This results in an optimal solution. For example:





However, if negative nodal prices are present, the solver will produce NPL. Graphically, the loss may be derived by using non-adjacent nodes, as below:



LineFlow:	Flow = Weight (O,O)* O + Weight (B,D)*B
LineLoss:	Loss = Weight (O,O)*O + Weight (B,D)*D
Weight:	1 = Weight (O,O) + Weight (B,D)

Instead of nodes (A,C) and (B,D), the solver uses origin (O,O) and node (B,D) to derive the loss. Obviously, there is an overstatement of the transmission loss, which is indicated on the above graph as CircuitError.

#### 2.3 How does the NEMS handle NPL?

The root cause of NPL lies in the employment of non-adjacent nodes to calculate the loss. Therefore, the NEMS mitigates this problem by reducing the solution range. Its methodology is:

- Step 1: The solver checks for the presence of non-adjacent nodes whose weights are both greater than zero. If any pair is found, it indicates a possible NPL case.
- Step 2: The solver calculates the CircuitError on each transmission circuit.
- Step 3: The solver sums all of the circuit errors into the total error, called SysError.
- Step 4: The solver checks whether the SysError is within the allowable tolerance. If it is, it ignores the error and produces the results. Otherwise, it proceeds onto Step 5.



• Step 5: The solver narrows the solution range for each circuit into the intersection of original range and [(LineFlow – SysError), (LineFlow + SysError)]. All of the constant nodes within this range are kept, while the outliers are removed.



• Step 6: The solver solves the case again and begins again at Step 1.

In the case where an accurate solution can only be found after many iterations, the NEMS adopts a compromise between accuracy and performance. If the SysError is less than a certain threshold<sup>1</sup> or the iteration goes up to a certain number<sup>2</sup>, the iteration will not carry on. Instead, the current result will be reported as acceptable.

A more detailed procedure of NPL handling is described in the Market Rules, as shown in Appendix A.

<sup>&</sup>lt;sup>1</sup> 10MW, in the current setting of the MCE.

<sup>&</sup>lt;sup>2</sup> 20 times, in the current setting of the MCE.



## 3.0 Case Study

#### 3.1 Simulation in offline environment

To study the process of the NPL handling, a negative price case was created in an offline environment for Period 10 on 6 October 2003. A rerun was conducted with the Raw Result flag turned on so that the detailed results of each iteration could be retrieved.

As expected, the NPL process was triggered as demonstrated by the Message Log:

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10 0d 2000 19:08:56       IDISPATCH::FORMULATE PJ:SETUP CONSTRAINTS       Seb06:PJ0:2::Constraint: 'UITERTIE OUTPUT LIMIT references branch not in LP         00 0d 2000 19:08:56       IDISPATCH::FORMULATE PJ:SETUP CONSTRAINTS       Sep06:PJ0:2::Constraint: 'UITERTIE_OUTPUT_LIMIT references branch not in LP         00 0d 2000 19:08:56       IDISPATCH::FORMULATE PJ:SETUP CONSTRAINTS       Sep06:PJ0:2::Constraint: 'UITERTIE_OUTPUT_LIMIT references branch not in LP         00 0d 2000 19:07:05       IDISPATCH::FORMULATE PJ:SETUP CONSTRAINTS       Sep06:PJ0:1::Constraint' 'UITERTIE_OUTPUT_LIMIT' references branch not in LP         00 0d 2000 19:07:05       IDISPATCH::FORMULATE PJ:SETUP CONSTRAINTS       Sep06:PJ0:1::Constraint' 'UITERTIE_OUTPUT_LIMIT' references branch not in LP         00 0d 2000 19:07:05       IDISPATCH::FORMULATE PJ:SETUP CONSTRAINTS       Sep06:PJ0:1::Constraint' 'UITERTIE_OUTPUT_LIMIT' references branch not in LP         00 0d 2000 19:07:04       IDISPATCH::FORMULATE PJ:SETUP CONSTRAINTS       Sep06:PJ0:::Constraint' 'UITERTIE_OUTPUT_LIMIT' references branch not in LP         01 0d 2000 19:07:04       IDISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:PJ0:::Foliatry OWSERY : STAGE1 : SER GF 'output at or below regulation minimum, regulation offer ignored         00 d2 2000 19:07:04       IDISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:PJ0::Falitry POWSERY : STAGE2 : SER GF 'output at or below regulation minimum, regulation offer ignored         00 d2 2000 19:06:35       IDISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:PJ0::Falitry POWSERY : STAGE2	10 Oct 2003 18:10:36	I	DISPATCH	Sep06:P10:2::Solution exhibits non-physical losses, SysError=82.3								
10 0d 2001 19/06156 I       DISPATCH::PORMULATE DI:SETUP CONSTRAINS       Sep06:P1012::Constraint: "UTRERLE_NPUT_LIMIT references branches         00 0d 2001 19/06156 I       DISPATCH::PORMULATE DI:SETUP CONSTRAINS       Sep06:P1012::Constraint: "UTRERLE_OUTPUT_LIMIT references branches         00 0d 2001 19/06157 I       DISPATCH::PORMULATE DI:SETUP CONSTRAINTS       Sep06:P1011::Constraint: "UTRERLE_OUTPUT_LIMIT references branch not in LP         00 0d 2001 19/0705 I       DISPATCH::PORMULATE DI:SETUP CONSTRAINTS       Sep06:P1011::Constraint: "UTRERLE_OUTPUT_LIMIT references branch not in LP         00 0d 2001 19/0705 I       DISPATCH::PREPARELOADFORECAST       Sep06:P1011::Constraint: "UTRERLE_OUTPUT_LIMIT references branches         10 0d 2000 18/07/04 I       DISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:P101::Fonsitru       Sep06:P101::Fonsitru         00 0d 2000 18/07/04 I       DISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:P101::Fonsitru       Sep06:P101::Fonsitru       Sep06:P101::Fonsitru         00 0d 2000 18/07/04 I       DISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:P101::Fonsitru       Sep06:P101::	10 Oct 2003 18:08:56	I	DISPATCH::FORMULATE LP::SETUP CONSTRAINTS	Sep06:P10:2::Constraint INTERTIE OUTPUT LIMIT' references branch not in LP								
10 0d 2001 19/05/5 1       DISPATCH::FORMULATE PJ::SETUP CONSTRAINTS       Sep06:FD101::Gostraint' INTERTE_ONTUP_LIMT' references branch not in P         10 0d 2001 19/07/05 1       DISPATCH::FORMULATE PJ::SETUP CONSTRAINTS       Sep06:FD101::Constraint' INTERTE_OUTUP_LIMT' references branch not in P         10 0d 2001 19/07/05 1       DISPATCH::FORMULATE PJ::SETUP CONSTRAINTS       Sep06:FD101::Constraint' INTERTE_OUTUP_LIMT' references branch not in P         10 0d 2001 19/07/05 1       DISPATCH::FORMULATE PJ::SETUP CONSTRAINTS       Sep06:FD101::Constraint' INTERTE_OUTUP_LIMT' references branch not in P         10 0d 2001 19/07/05 1       DISPATCH::FORMULATE PJ::SETUP BRANCHES       Sep06:FD101::Constraint' INTERTE_OUTUP_LIMT' references branch s         10 0d 2001 19/07/04 1       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:FD101::Roits/rule/Ser06:FD10::readit' PowsERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored         10 0d 2001 19/07/04 1       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:FD10::Faolity POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored         10 0d 2001 19/06:36 W       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:FD10::Faolity POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored         10 0d 2001 19/06:36 I       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:FD10::Faolity POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored         10 0d 2001 19/06:36 I       DISPATCH::REPARAING RU	10 Oct 2003 18:08:56	1	DISPATCH::FORMULATE LP::SETUP CONSTRAINTS	SepU6:P10:2::Constraint INTERTIE_INPUT_LIMIT references unit not in LP								
10 0F 2001 18/03/55 1       DISPATCH::FORMULATE LP::SETUP CONSTRAINTS       Sep06:FU01::Constraint:'UITERTEOUTUUT_LINIT' references branch not in LP         00 0F 2003 18/07/05 1       DISPATCH::FORMULATE LP::SETUP CONSTRAINTS       Sep06:FU01::Constraint:'UITERTEOUTUUT_LINIT' references branch not in LP         00 0F 2003 18/07/05 1       DISPATCH::FORMULATE LP::SETUP CONSTRAINTS       Sep06:FU01::Constraint:'UITERTENPUT_LINIT' references branch not in LP         00 0F 2003 18/07/04 I       DISPATCH::PREPARELOADFORECAST       Sep06:FU01::Constraint:'UITERTENPUT_LINIT' references branch not in LP         00 0F 2003 18/07/04 I       DISPATCH::PREPARELOADFORECAST       Sep06:FU01::Fonitry VOVSERY : STAGE1 : TLA G1' output at or below regulation minimum, regulation offer ignored         00 0F 2003 18/07/04 I       DISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:FU0::Fanitry VOVSERY : STAGE2 : SER G5' output at or below regulation minimum, regulation offer ignored         00 0F 2003 18/07/04 I       DISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:FU0::Fanitry VOVSERY : STAGE2 : SER G5' output at or below regulation minimum, regulation offer ignored         00 0F 2003 18/07/04 I       DISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:FU0::Fanitry VOVSERY : STAGE2 : SER G5' output at or below regulation minimum, regulation offer ignored         00 0F 2003 18/07/04 I       DISPATCH::VALIDATEREGULATIONSUBMISSIONS       Sep06:FU0::Fanitry VOVSERY : STAGE2 : SER G5' output at or below regulation minimum, regulation offer ignored         00 0F 2003 18/07/04 I       DISPATCH::V	10 Oct 2003 18:08:55	1	DISPATCH: FORMULATE LPT: SETUP BRANCHES	Sepus P10:2::No observed reactive power flow available for 2 branches								
10 0F2003 18/07/05       1       DISPATCH::FORMULATE DI:SETUP CONSTRAINTS       Sep06/F10/11:Constraint: 'UTRETE_DUPC_INTRAINTS         10 0F2003 18/07/05       1       DISPATCH::FORMULATE DI:SETUP CONSTRAINTS       Sep06/F10/11:Constraint: 'UTRETE_DUPC_INTRAINTS         10 0F2003 18/07/05       1       DISPATCH::FORMULATE DI:SETUP CONSTRAINTS       Sep06/F10/11:Constraint: 'UTRETE_INPUT_UINT' references unt ont in D         10 0F2003 18/07/05       1       DISPATCH::FORMULATE DI:SETUP CONSTRAINTS       Sep06/F10/11:Constraint' 'UTRETE_INPUT_UINT' references unt ont in D         10 0F2003 18/07/04       1       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10/11:Constraint' UTRETE MS' very short term load forecast file available for 2 tranches         10 0F2003 18/07/04       1       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10/11:Faolity POWSERY : STAGE1 : ER G1 output at or below regulation minimum, regulation offer ignored         10 0F2003 18/07/04       1       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Faolity POWSERY : STAGE2 : SER G5 output at or below regulation minimum, regulation offer ignored         10 0F2003 18/07/04       1       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Faolity POWSERY : STAGE2 : SER G5 output at or below regulation minimum, regulation offer ignored         10 0F2003 18/06:36       I       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Faolity POWSERY : STAGE2 : SER G5 output at or below regulation minimum, regulation offer ignored	10 Oct 2003 18:08:55	1	DISPATCH	Sepus Provide Solution exhibits non-physical losses, Systemor=150.2								
10 00 2000 18/07/04       DISPATCH::PREPARELOADFORECAST       Sep06:F10.10::Initia Units MICALIC_UP with a valiable for 2 branches         10 00 2000 18/07/04       DISPATCH::PREPARELOADFORECAST       Sep06:F10.10::Initia Units MICALIC_UP with a valiable for 2 branches         10 00 2000 18/07/04       DISPATCH::PREPARELOADFORECAST       Sep06:F10.10::Initia Units MICALIC_UP with a valiable for 2 branches         10 00 2000 18/07/04       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:F10.10::Initia Units MICALIC_UP with a valiable for 2 branches         10 00 2000 18/07/04       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:F10.10::Initia Units MICALIC_UP with a valiable for 2 branches         10 00 2000 18/07/04       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:F10.10::Initia UNITS MICALICASE (Structus 4 or below regulation minimum, regulation offer ignored         10 00 2000 18/07/04       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:F10.:Faility 'POWSERY : STAGE1 : SER G1 output 4 or below regulation minimum, regulation offer ignored         10 00 2000 18/06:36       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:F10.:Faility 'POWSERY : STAGE1 : SER G1 output 4 or below regulation minimum, regulation offer ignored         00 02 2000 18/06:36       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:F10::Faility 'POWSERY : STAGE1 : SER G1 output 4 or below regulation minimum, regulation offer ignored         00 02 2000 18/06:36       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06:F10::Faility 'POWSERY : STAGE1 : SER G1 output 4 or below	10 Oct 2003 18:07:05	1	DISPATCH: FORMULATE LP::SETUP CONSTRAINTS	Sep06:P10:1::Constraint_INTERTIE_OUTPOT_LIMIT_references branch not in LP								
100 04 2003 18/07.04 I       DISPATCH: VALIDATEREGULATIONSUBMISSION       Sep06:F10.1:/0 Usrspatch: ERS very short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast file available for 2003-Sep-06 P10 Using ERS short term load foreast for uptored to relative memory equidation minimum, regulation offer ignored Sep06:P10::Facility POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored Sep06:P10::Facility POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored Sep06:P10::Facility POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored Sep06:P10::Facility POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored Sep06:P10::Facility POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored Sep06:P10::Facility POWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored Sep06:P10::Facitrenter P	10 Oct 2003 18:07:05	1	DISPATCHUEODMULATE LOUSETUD BDANCHES	SepterProvide and an and the second s								
30 Oct 2000 18/07:04       DISPATCH::/REPARELOADDORECAST       DISPATCH::/REPARELOADDORECAST         00 Oct 2000 18/07:04       I       DISPATCH::/VALIDATEREGULATIONSUBMISSIONS       Sep06:P10::Facility POWSERY : STAGE3 : SER GS output at or below regulation minimum, regulation offer ignored         00 oct 2000 18/07:04       I       DISPATCH::/VALIDATEREGULATIONSUBMISSIONS       Sep06:P10::Facility POWSERY : STAGE3 : SER GS output at or below regulation minimum, regulation offer ignored         00 oct 2000 18/07:04       I       DISPATCH::/VALIDATEREGULATIONSUBMISSIONS       Sep06:P10::Facility POWSERY : STAGE3 : SER GS output at or below regulation minimum, regulation offer ignored         00 oct 2000 18/07:04       I       DISPATCH::/VALIDATEREGULATIONSUBMISSIONS       Sep06:P10::Facility POWSERY : STAGE3 : SER GS output at or below regulation minimum, regulation offer ignored         00 oct 2000 18/07:04       I       DISPATCH::/VALIDATEREGULATIONSUBMISSIONS       Sep06:P10::Facility POWSERY : STAGE3 : SER GS output at or below regulation minimum, regulation offer ignored         00 oct 2000 18/06:36       I       DISPATCH::/VALIDATEREGULATIONSUBMISSIONS       Sep06:P10::Facility POWSERY : STAGE3 : SER GS output at or below regulation minimum, regulation offer ignored         00 oct 2000 18/06:36       I       DISPATCH::/REPARING RUN       Sep06:P10::Facility POWSERY : STAGE3 : SER GS output at or below regulation minimum, regulation offer ignored         00 oct 2000 18/06:36       I       DISPATCH::/REPARING RUN       Sep06:P10::Secoring peri	10 Oct 2003 18:07:03	I	DISPATCH: PREPARE OADEORECAST	Sep06.P10.1.No observed reactive power now available for 2 branches Sep06.P10.: Demand figures for period 2003-Sep.06 P10 created earlier than beginning of prior (	neriod							
10 0d 2003 18:07:04 I       DISPATCH::VALIDATEREGULATIONSUMISSIONS       Sep06:FDI::Facility TUASPOW : STAGE1 : TUA G1 output at or below regulation minimum, regulation offer ignored         10 0d 2003 18:07:04 I       DISPATCH::VALIDATEREGULATIONSUMISSIONS       Sep06:FDI::Facility TVASPOW : STAGE1 : STAGE3 : SER G9 output at or below regulation minimum, regulation offer ignored         10 0d 2003 18:07:04 I       DISPATCH::VALIDATEREGULATIONSUMISSIONS       Sep06:FDI::Facility FOWSERY : STAGE3 : SER G9 output at or below regulation minimum, regulation offer ignored         10 0d 2003 18:07:04 I       DISPATCH::VALIDATEREGULATIONSUMISSIONS       Sep06:FDI::Facility FOWSERY : STAGE3 : SER G9 output at or below regulation minimum, regulation offer ignored         10 0d 2003 18:06:36 I       DISPATCH::PREPARING RUN ::GETDATASOURCES       Sep06:FDI::Facility FOWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored         10 0d 2003 18:06:36 I       DISPATCH::PREPARING RUN ::GETDATASOURCES       Sep06:FDI::Facility FOWSERY : STAGE1 : SER G1 output at or below regulation minimum, regulation offer ignored         10 0d 2003 18:06:35 I       DISPATCH::PREPARING RUN ::GETDATASOURCES       Sep06:FDI::Facility FOWSERY : STAGE : SER G1 output at or below regulation minimum, regulation offer ignored         10 0d 2003 18:06:35 I       DISPATCH::PREPARING RUN ::GETDATASOURCES       Sep06:FDI::No current ENS network status file available         10 0d 2003 18:06:31 I       DISPATCH::PREPARING RUN        Solver version 3.1.5       Requiset to start solver sent to queue NEM AQ_MC, RUN, INIT,	10 Oct 2003 18:07:04	w	DISPATCH::PREPARELOADFORECAST	Seption-10. Demand ingules for period 2000-Sep-00 F10 dealed earlier than beginning of prior Seption-P10::No current EMS very short term load forecast file available for 2003-Sep-06 P10. Us	ing EMS short term load							
10 04 2003 18/07/14       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Facility POWSERY: STAGE: ISE G5 output at or below regulation minimum, regulation offer ignored         10 04 2003 18/07/04       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Facility POWSERY: STAGE: ISE G5 output at or below regulation minimum, regulation offer ignored         10 04 2003 18/07/04       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Facility POWSERY: STAGE: ISE G5 output at or below regulation minimum, regulation offer ignored         10 04 2003 18/07/04       DISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Facility POWSERY: STAGE: ISE G1 output at or below regulation minimum, regulation offer ignored         10 04 2003 18/06/36       IDISPATCH::VALIDATEREGULATIONSUMMISSIONS       Sep06/F10::Facility POWSERY: STAGE: ISE G1 output at or below regulation minimum, regulation offer ignored         10 04 2003 18/06/36       IDISPATCH::PREPARING RUN::GETDATASOURCES       Sep06/F10::Facility POWSERY: STAGE: ISE G1 output at or below regulation minimum, regulation offer ignored         10 04 2003 18/06/36       IDISPATCH::PREPARING RUN       Sep06/F10::Facility POWSERY: STAGE: ISE G1 output at or below regulation minimum, regulation offer ignored         10 04 2003 18/06/35       IDISPATCH::PREPARING RUN       Sep06/F10::No current EMS network status file available         10 04 2003 18/06/35       IDISPATCH::PREPARING RUN       Solver version 3.1.5         10 04 2003 18/06/31       IDISPATCH::PREPARING RUN       Run ID C5555596794614E02033309010AEDE6 <td>10.0+000010.07.01</td> <td></td> <td></td> <td>forecast file instead.</td> <td>lation offension and</td>	10.0+000010.07.01			forecast file instead.	lation offension and							
10 002 1007/04 1       DISPATCH::RESULTIONSUMISSION       Septiol:12.::Result POWSERY : STAGE2 : SER G4 output at or below regulation minimum, regulation offer ignored         10 002 1003 18/07/04 1       DISPATCH::VALIDATEREGULATIONSUMISSIONS       Septiol:12.::Result POWSERY : STAGE2 : SER G4 output at or below regulation minimum, regulation offer ignored         10 002 1003 18/07/04 1       DISPATCH::VALIDATEREGULATIONSUMISSIONS       Septiol:12.::Result POWSERY : STAGE2 : SER G4 output at or below regulation minimum, regulation offer ignored         10 002 1003 18/07/04 1       DISPATCH::VALIDATEREGULATIONSUMISSIONS       Septiol:12.::Raility POWSERY : STAGE2 : SER G4 output at or below regulation minimum, regulation offer ignored         10 002 1003 18/06:36 I       DISPATCH::REPARING RUN       Septiol:12.::Raility POWSERY : STAGE2 : SER G4 output at or below regulation minimum, regulation offer ignored         10 002 1003 18/06:36 I       DISPATCH::REPARING RUN       Septiol:12.::Result POWSERY : STAGE2 : SER G4 output at or below regulation minimum, regulation offer ignored         10 002 1003 18/06:35 I       DISPATCH::REPARING RUN       Septiol:10:::Rource method is network status file available         10 002 1003 18/06:35 I       DISPATCH::REPARING RUN       Solver version 3.1.5         10 002 1003 18/06:31 I       NEMMSTC_RUNC_REQUEST       NeMMSTC_RUNC_RUNC_RUNC_RUNLINT_Q: parameters:         10 002 2003 18/06:31 I       NEMMSTC_RUNC_RUN       Nu ID CSSSSE067964614E0303309010AEDE6         10 002 2003 18/06:31 I       NEMMSTC_RU	10 Oct 2003 18:07:04	1	DISPATCH: VALIDATEREGULATIONSUBMISSIONS	September 2011 - September 2011 - STAGE1 - FOA G1 output at or below regulation minimum, regulation security - STAGE2 - SED C0' output at or below regulation minimum,	lation offer ignored							
10 002 1000 1100 / 1000 11000 11000 11000 11000 11000 11000 11000 11000 11000 11000 11000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 1100000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 1100000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 110000 11000000	10 Oct 2003 18:07:04	1	DISPATCHVALIDATEREGULATIONSUBMISSIONS	September 2011 - Facility POWSERY - STAGES - SER G9 output at or below regulation minimum, regulation mini	lation offer ignored							
10 002 1007:04       1       DISPATCH::RESULTIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMALTICONSUMALINATIONSUMINATIONSUMINATIONSUMINATIONSUMINATIONSUMINAT	10 Oct 2003 10:07:04	T	DISPATCHVALIDATEREGULATIONSUBMISSIONS	September 20. Facility 'POWSER' : STAGE2 : SER G5 output at or below regulation minimum, regulation minimu	lation offer ignored							
30 04 2003 18:06:36       IDISPATCH::RETPARING RUN XLGETATASOURCES       Sep06:P10::000KT 10:00KT 10:	10 Oct 2003 18:07:04	ī	DISPATCH::VALIDATEREGULATIONSUBMISSIONS	Sep06:P10: Facility 'POWSERY : STAGE1 : SER G1' output at or below regulation minimum, regulation	lation offer ignored							
Dord 2003 18:06:36       DISPATCH:       PEPARTING RUM::GETDATASOURCES       Sep06/P10::Processing period 2003-Sep-06 P10         Di Ord 2003 18:06:36       I       DISPATCH::PREPARING RUM::GETDATASOURCES       Sep06/P10::Bourding dematder dudued 2003-Sep-06 P10         Di Ord 2003 18:06:36       I       DISPATCH::PREPARING RUM::GETDATASOURCES       Sep06/P10::Bourding dematder dudued 2003-Sep-06 P10         Di Ord 2003 18:06:35       I       DISPATCH::PREPARING RUM       Sep06/P10::Bourding dematder dudued 2003-Sep-06 P10         Di Ord 2003 18:06:35       I       DISPATCH::PREPARING RUM       Host: EMCMMC10         Di Ord 2003 18:06:31       I       DISPATCH::PREPARING RUM       Not: EMCMMC10         Di Ord 2003 18:06:31       I       DISPATCH::PREPARING RUM       Request to start solver sent to queue NEM.AQ.MC.RUN.INIT.Q: parameters:         C 003 18:06:31       I       NEMMSC.RUMS.SUBMIT.RUN_MC_REQUEST       Request to start solver sent to queue NEM.AQ.MC.RUN_INIT.Q: parameters:         C 003 18:06:31       I       NEMMSC.RUMS.SUBMIT.RUN_MC_REQUEST       MC Manual Run submitting CHS35556794416E00303009010AEDE6[MCIIV/SS         D 0 04 2003 18:06:31       I       RUM PROCEDURE       Submitting DEGN memor_unstart, MC_RNO_MCRN_0N_UN_INIT.Q: parameters:         D 0 04 2003 18:06:31       I       RUM PROCEDURE       Submitting DEGN memor_unstart, MC_RNO_NCRN_0N_UN_INIT.Q: Parameters:         D 0 04 2003 18:06:3	10 Oct 2003 18:06:36	W	DISPATCH: GET NETWORK DATA	Sep06:P10::Using connectivity borizon older than NWS LIFETIME threshold	lation offer ignored							
10 Oct 2003 18:06:35 I DISPATCH::PREPARIING RUN::GETDATASOURCES Sep06:P10::Sourcing generator outputs from prior period dispatch 10 Oct 2003 18:06:35 I DISPATCH::PREPARIING RUN::GETDATASOURCES Sep06:P10::Sourcing generator outputs from prior period dispatch 10 Oct 2003 18:06:35 I DISPATCH::PREPARING RUN Solver version 3.1.5 10 Oct 2003 18:06:34 I DISPATCH::PREPARING RUN Solver version 3.1.5 10 Oct 2003 18:06:32 I NEM\$MC_RUNS.SUBMIT_RUN_MC_REQUEST Request to tatis solver acts to queue MEN.AQ_MC_RUN_INIT_Q: parameters: C953559E7964B16E0303309010AEDE6 (SUPVES) 10 Oct 2003 18:06:31 I NEM\$START_MC_RUN MC MC MC MAIL ADEDE6 (FORLIVES) 10 Oct 2003 18:06:31 I NEM\$START_MC_RUN MC MC MAIL ADEDE6 (FORLIVES) 10 Oct 2003 18:06:31 I NUN PROCEDURE Submitting BEGIN nemmer, cruns.start_MC_run(RR; 106:5EP-03):10',06:5EP- 03',10',10',17',C583559E6794B16E0303309010AEDE6 (FORLIVES) 10 Oct 2003 18:06:31 I NUN PROCEDURE Submitting DEGIN nemmer, cruns.start_MC_run(RR; 106:5EP-03):10',06:5EP- 03',10',10',17',C583559E6794B16E0303309010AEDE6 (FORLIVES) 10 Oct 2003 18:06:31 I NUN PROCEDURE Submitting DEGIN nemmer, cruns.start_MC_run(RR; 106:5EP-03):10',06:5EP- 03',10',10',17',10',10',10',10',10',10',10',10',10',10	10 Oct 2003 18:06:36	ī	DISPATCH	Sep06:P10::Processing period 2003-Sep-06 P10								
10 Oct 2003 18:06:35 W DISPATCH::PREPARIING RUN::GETDATASOURCES Sep06:P10::No current EMS network status file available 10 Oct 2003 18:06:35 I DISPATCH::PREPARIING RUN Host: EMC/MC10 00 42:003 18:06:35 I DISPATCH::PREPARING RUN Solver vertion 3.1.5 10 Oct 2003 18:06:34 I DISPATCH::PREPARING RUN RUN RUN UND COSSSPECT/94641E6030309010AEDE6 10 Oct 2003 18:06:31 I NEM\$STAT_MC_RUN CREQUEST CS\$55596794641E6030309010AEDE6 10 Oct 2003 18:06:31 I RUN PROCEDURE MC Available RUN submitting OSSSPECF39461E6030309010AEDE6 10 Oct 2003 18:06:31 I RUN PROCEDURE MC Available RUN Submitting DEGIN network start Solver sent to queue NEN AQ_MC_RUN_INIT_Q: parameters:	10 Oct 2003 18:06:36	ī	DISPATCH::PREPARING RUN::GETDATASOURCES	Sep06:P10::Sourcing generator outputs from prior period dispatch								
10 Oct 2003 18:06:35         I         DISPATCH::PREPARING RUN         Host: EMCPMC10           10 Oct 2003 18:06:35         I         DISPATCH::PREPARING RUN         Solver version 3.1.5           10 Oct 2003 18:06:31         I         DISPATCH::PREPARING RUN         Solver version 3.1.5           10 Oct 2003 18:06:32         I         NEM\$MC_RUNS.SUBMIT_RUN_MC_REQUEST         Run JL OC\$SSS95667946116E030330910AEDE6           10 Oct 2003 18:06:31         I         NEM\$START_MC_RUN         MC Manual Run submitting C95359667946116E030330910AEDE6           10 Oct 2003 18:06:31         I         NEM\$START_MC_RUN         MC Manual Run submitting C95359667946116E030330910AEDE6           10 Oct 2003 18:06:31         I         RUN PROCEDURE         Submitting C95359667946116E0303309010AEDE6           10 Oct 2003 18:06:31         I         RUN PROCEDURE         Submitting C9535966794616E0303309010AEDE6           10 Oct 2003 18:06:31         I         RUN PROCEDURE         Submitting C9535966794616E0303309010AEDE06// Menual Run 1065780386779, C9535966794816E0303309010AEDE06// Menual Run 1065780386779, C9535956794816E0303309010AEDE06// END;	10 Oct 2003 18:06:36	w	DISPATCH::PREPARING RUN::GETDATASOURCES	Sep06:P10::No current EMS petwork status file available								
10 Oct 2003 18:06:35 I DISPATCH::PREPARING RUN Solver version 3.1.5 10 Oct 2003 18:06:34 I DISPATCH::PREPARING RUN Solver version 3.1.5 10 Oct 2003 18:06:32 I NEMMAC_RUNS.SUBMIT_RUN_MC_REQUEST Request to start solver sent to queue NEM AC_MC_RUN_INIT_Q: parameters: COS3555965796418E06033309010AEDE6 Request to start solver sent to queue NEM AC_MC_RUN_INIT_Q: parameters: COS3555965796418E06033309010AEDE6 Submitting OS355596794418E06033309010AEDE6 Submitting OS355596794418E06033309010AEDE6 Submitting OS355596794418E06003309010AEDE6 Submitting OS3555967944218E0603309010AEDE6 Submitting OS3555967944218E0603309010AEDE6 Submitting OS355967944218E06003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0003309010AEDE6 Submitting OS355967944218E0000309010AEDE6 Submitting OS355967944218E00003009010AEDE6 Submitting OS355967944218E0000309010AEDE6 Submitting OS355967944218E0000309010AEDE6 Submitting OS355967944218E000000 Submitting OS35596796794218E000000 Submitting OS35596796796796796796796796	10 Oct 2003 18:06:35	T	DISPATCH::PREPARING RUN	Host: EMCPMC10								
10 Oct 2003 18:06:34         I         DISPATCH::REFARING RUN         Run ID C953555967964B16E0303309010AEDE6           10 Oct 2003 18:06:32         I         NEM\$MC_RUNS.SUBMIT_RUN_MC_REQUEST         Request to start solver sent to queue NMA_C_RUN_NIT_Q: parameters: C9535559667964B16E0303309010AEDE6[BMCINVES           10 Oct 2003 18:06:31         I         NEM\$START_MC_RUN         MC Manual Run submiting C953559667964B16E0303309010AEDE6           10 Oct 2003 18:06:31         I         NUN PROCEDURE         MC Manual Run submiting C953559667964B16E0303309010AEDE6           10 Oct 2003 18:06:31         I         RUN PROCEDURE         Submiting C953559667964B16E0303309010AEDE6           10 Oct 2003 18:06:31         I         RUN PROCEDURE         Submiting C953559667964B16E0303309010AEDE6           10 Oct 2003 18:06:31         I         RUN PROCEDURE         Submiting C953559667964B16E0303309010AEDE6           00*/10*/W         Y*/C59AE51E454742E0303309010AEDE6         Submiting C953559667964B16E0303309010AEDE6           00*/2003 18:06:31         I         RUN PROCEDURE         Submiting C9535966794B16E0303309010AEDE6           00*/2003 18:06:31         I         RUN PROCEDURE         Submiting C9535966794B16E0303309010AEDE6           00*/2003 18:06:31         I         RUN PROCEDURE         Submiting C9535966794B16E0303309010AEDE6           00*/2003 18:06:31         I         RUN PROCEDURE <t< td=""><td>10 Oct 2003 18:06:35</td><td>I</td><td>DISPATCH::PREPARING RUN</td><td>Solver version 3.1.5</td><td></td></t<>	10 Oct 2003 18:06:35	I	DISPATCH::PREPARING RUN	Solver version 3.1.5								
10 Oct 2003 18:06:32 I NEM\$MC_RUNS.SUBMIT_RUN_MC_REQUEST Request to start solver sent to queue NEN AQ_MC_RUN_INIT_Q: parameters: C953559567964B16E030330901ABDE6[KGI/WVES 10 Oct 2003 18:06:31 I NEM\$START_MC_RUN MC AMUN BEGIN nemmer, runs start_MC_run(RR*) (65-56P-03'10'/06-SEP- 03'10'/0', ''/C64351F4342B03309010AEDE6(KGI/WVES) 03'10'/0', ''/C64351F4342B03309010AEDE6(KGI/WVES) Done Determine the sent solution of the sent s	10 Oct 2003 18:06:34	I	DISPATCH::PREPARING RUN	Run ID C953559E67964B16E0303309010AEDE6								
10 Oct 2003 18:06:31 I NEM\$START_MC_RUN MC Manual Run submitting C953S9567964B162003309010AEDE6 Submitting C953S9567964B162003309010AEDE6 Submitting C953S9567964B162003309010AEDE6 D0rec	10 Oct 2003 18:06:32	I	NEM\$MC_RUNS.SUBMIT_RUN_MC_REQUEST	Request to start solver sent to queue NEM.AQ_MC_RUN_INIT_Q: parameters:								
10 Oct 2003 13:06:31 1         RUN PROCEDURE         Submitting BEGIN nemting, runs.start, MC_run('RER')'06-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',06'-SEP-03',10',10',10',10',10',10',10',10',10',10	10 Oct 2003 18:06:31	T	NEM\$START MC RUN	MC Manual Run submitting C953559E67964B16E0303309010AEDE6								
03''.10''W' (0','Y','C69AE51EF4542E742E3033390901AE600','Manual Run 1065780388779','C953559E67924B16E0303309010AE0E6'); END;	10 Oct 2003 18:06:31	I	RUN PROCEDURE	Submitting BEGIN nem\$mc runs.start MC run('RER','06-SEP-03','10','06-SEP-								
1065780380779',C95355967924B16E0303309010AEDE6'); END;				03','10','M <sup>'</sup> ,'0','Y','C69AE51EF4542F42E0303309010AE00D','Manual Run								
				1065780388779','C953559E67924B16E0303309010AEDE6'); END;								
		an	lo lo									

By reading the raw results from each iteration, the SysErrors in the multiple iterations can be summarised in the table:

Iteration	SysError (MW)
1	150.2
2	82.3
3	49.0
4	20.7
5	3.8



0

0 0.040531045

A branch that bore	e non-pri	ysical loss	S (A.RAJE	I-A . Z	30. ГПУ-	1 F 1) Wa		erveu a	as ionows.					
INVES environment	DPR, P10	6-Sep-03			SysError			NewBound			FinalResult			
A.RAJH-X : 230 : FHV-TF1				where	NewBound =	{flow – <mark>S</mark> y	/sError,	flow + <mark>Sy</mark>	sError}					
1									J					
Line	Rating	х	R		1	2	3	4	5	6	7	8	9	Result
A.RAJH-X : 230 : FHV-TF1	500	-0.007649	0.00018	FLOW	-500	-375	-250	-125	0	125	250	375	500	143.378
				LOSS	0.45	0.253125	0.1125	0.028125	i 0	0.028125	0.1125	0.253125	0.45	0.041
Iteration 1	150.2	2		Weight	0.335148217	0	0	0	0	0	0	0	0.664851783	
			Flow*We	ight:	-167.5741085	0	0	0	0	0	0	0	332.4258915	164.8517829
			Loss*We	ight:	0.150816698	0	0	0	0	0	0	0	0.299183302	0.45
				-										
2	NewBound:	14.65178291	315.0517829						J	-				
Line	Rating	х	R		1	2	3	4	5	6	7	8	9	Result
A.RAJH-X : 230 : FHV-TF1	500	-0.007649	0.00018	FLOW	0	0	0	0	14.65178291	125	250	315.0517829	0	143.378
				LOSS	0	0	0	0	0.003296651	0.028125	0.1125	0.185683256	0	0.041
Iteration 2	82.3	5		Weight	0	0	0	0	0.526776742	0	0	0.473223258	0	1
			Flow*We	ight:	0	0	0	0	7.71821846	0	0	149.0898312	0	156.8080497
			Loss*We	ight:	0	0	0	0	0.001736599	0	0	0.087869635	0	0.089606234
				-										
3	NewBound:	74.5080497	239.1080497			-			J	1				
Line	Rating	х	R		1	2	3	4	5	6	7	8	9	Result
A.RAJH-X : 230 : FHV-TF1	500	-0.007649	0.00018	FLOW	0	0	0	0	74.5080497	125	239.1080497	0	0	143.378
				LOSS	0	0	0	0	0.016764311	0.028125	0.105147934	0	0	0.041
Iteration 3	49	)		Weight	0	0	0	0	0.535131933	0	0.464868067	0	0	1
			Flow*We	ight:	0	0	0	0	39.87163669	0	111.1536968	0	0	151.0253334
			Loss*We	ight:	0	0	0	0	0.008971118	0	0.048879917	0	0	0.057851035
-														
4	NewBound:	102.0253334	200.0253334					-	J			-		
Line	Rating	X	R	-	1	2	3	4	5	6	1	8	9	Result
A.RAJH-X : 230 : FHV-TF1	500	-0.007649	0.00018	FLOW	0	0	0	0	102.0253334	125	200.0253334	0	0	143.378
				LOSS	0	0	0	0	0.0229557	0.028125	0.0787671	0	0	0.041
Iteration 4	20.7			weight	0	0	0	0	0.548509841	0	0.451490159	0	0	
			Flow*We	ight:	0	0	0	0	55.96189943	0	90.30946959	0	0	146.271369
			Loss*We	ight:	0	0	0	0	0.012591427	0	0.035562571	0	0	0.048153998
-			100.074000											
5	NewBound:	125.571369	166.971369			•	•		J	<u>^</u>	-			Desself
	Rating	A 0.007040	K 0.00010			2	3	4	5	6	100.074000	8	9	Kesuit
A.RAJH-X : 230 : FHV-TF1	500	-0.007649	0.00018	FLOW	0	0	0	0	0	125.571369	166.971369	0	0	143.378
lteretier 5				LUSS	0	0	0	0	0	0.028510674	0.056455674	0	0	0.041
	3.8	2	Elevet M-	vveight	0	0	0	0	0	0.56985611	0.43014389	0	0	140.0700004
			Flow*We	ight:	0	0	0	0	0	/1.55/61192	/1.821/1414	0	0	143.3793261

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0

0

#### A branch that have non-physical loss (A RA IH-X : 230 : EHV-TE1) was observed as follows:

Flow\*Weight: Loss\*Weight:

0 0.016246982 0.024284063

0



It was noted that adjacent nodes were used in the final iteration so as to eliminate the CircuitError on this branch.

However, it is not always true that the iterations narrow down to adjacent nodes, as observed on another branch (A.RAJH-X : 230 : EHV-TF1).



INVES environment A.RAJAH : 230 : EHV-TF 1	DPR, P10	6-Sep-03	I	where	SysError NewBound	= {flow - S	/sError, flov	NewBound v + <mark>SysEr</mark> r	ror}		FinalResult			
1														
Lino	Poting	v	D	<sup> </sup>	1 1	2	2		5	6	7	•	<u> </u>	Recult
	Rating	A 0.17000	<b>K</b>	FL OW	150	<u> </u>	3	4	3	0 07 5	75	0	9 150	
A.RAJAH : 230 : EHV-IF I	150	0.17822	0.00107	FLOW	-150	-112.5	-/5	-37.5	<u> </u>	37.5	/5	112.5	150	38.108
	150.0		<b> </b>	LOSS	0.24075	0.13542188	0.0601875	0.015047	0	0.01504688	0.0601875	0.135421875	0.24075	0.024
Iteration 1	150.2	<b> </b>	<b>F</b> 1 <b>*</b> 14/	vveight	0.3690597	0	0	0	0	0	0	0	0.63094028	
			Flow^Wei	ignt:	-55.358958	0	0	0	0	0	0	0	94.64104203	39.28208
			Loss*Wei	ight:	0.0888511	0	0	0	0	0	0	0	0.151898872	0.24075
2	NewBound:	-110.9179159	189.4820841						J					
Line	Rating	Х	R		1	2	3	4	5	6	7	8	9	Result
A.RAJAH : 230 : EHV-TF 1	150	0.17822	0.00107	FLOW	0	-110.91792	-75	-37.5	0	37.5	75	112.5	150	38.108
				LOSS	0	0.13224782	0.0601875	0.015047	0	0.01504688	0.0601875	0.135421875	0.24075	0.024
Iteration 2	82.3			Weight	0	0.42459013	0	0	0	0	0	0	0.575409871	
			Flow*We	ight:	0	-47.094652	0	0	0	0	0	0	86.31148067	39.21683
			Loss*We	ight:	0	0.05615112	0	0	0	0	0	0	0.138529926	0.194681
	-	·	-	· ·		·	•							·
3	NewBound:	-43.08317155	121.5168285		1			,	J			·		
Line	Rating	x	R		1	2	3	4	5	6	7	8	9	Result
A.RAJAH : 230 : EHV-TF 1	150	0.17822	0.00107	FLOW	0	0	-43.083172	-37.5	0	37.5	75	112.5	121.5168285	38,108
	1			LOSS	0	0	0.0217676	0.015047	0	0.01504688	0.0601875	0.135421875	0.160747892	0.024
Iteration 3	49			Weight	0	0	0.5024207	0	0	0	0	0	0 497579263	
		¶	Flow*We	iaht:	0	0	-21.645879	0	0	0	0	0	60,46425399	38,81838
		<b>├</b> ───┤	Loss*We	iaht:	0	0	0.0109365	0	0	0	0	0	0 079984818	0.090921
		<u></u>		gna		-	0.0100011			- 1	-		0.0.000.012	0.00002
4	NewBound:	-10 1816248	87 8183752	·	1									
- Line	Pating	Y	P	<sup> </sup>	1	2	3	4	5	6	7	8	<u> </u>	Posult
	150	A 0 17922	0.00107	EL OW		2	3	4	<b></b>	37.5	75	97 9193752	3	29 109
A.RAJAH . 230 . EHV-TP T	150	0.17022	0.00107	LOSS	0	0	0	-10.10102		0.01504699	0.0601975	0.085004365	0	0.024
Iteration 4	20.7			LU33	0	0	0	0.004005		0.01304088	0.0001075	0.005904505	0	0.024
iteration 4	20.7	4	<b>E</b> lau/\$\\/a	weight	0	0	0	0.004000	0	0	0	0.495334549	0	20.20140
		<b>↓</b>		igni:	0	0	0	-5.130314	<u> </u>	0	0	43.4994/02/	0	38.30110
			Loss we	ignt:	U	U	U	0.002062	U	U	U	0.0425514	U	0.044013
		47.004404	50 004 404						<u> </u>					
5	NewBound:	17.661161	59.061161	µ'	<u> </u>				<u> </u>					
Line	Rating	X	R		1	2	3	4	5	6	7	8	9	Result
A.RAJAH : 230 : EHV-TF 1	150	0.17822	0.00107	FLOW	0	0	0	0	17.661161	37.5	59.061161	0	0	38.108
				LOSS	0	0	0	0	0.0070865	0.01504688	0.04100112	0	0	0.024
Iteration 5	3.8			Weight	0	0	0	0	0.5060183	0	0.49398169	0	0	
			Flow*We	ight:	0	0	0	0	8.9368708	0	29.1751322	0	0	38.112
			Loss*We	ight:	0	0	0	0	0.0035859	0	0.0202538	0	0	0.02384



Though non-adjacent nodes are still presented in the solution, the iterations stopped because the SysError dropped below the threshold of 10MW.



### 3.2 An actual case in the NEMS

During the operation of the NEMS, cases of NPL occasionally occur. The most recent case occurred on 25 January 2004 when the USEP became negative from Period 5 to Period 10, as illustrated by the screenshot:

Pet       East       Umerate       Type 3 questors for help       - 6 ×         Pet       Dial       Dial <thdial< th="">       Dial       Dial</thdial<>	🔀 Micro	osoft Excel - M	IView_v7.3.3.xls												_ 8	×
Control C	🖳 Ele	<u>E</u> dit ⊻iew	Insert Format To	ols <u>D</u> ata <u>W</u> indov	Help Acrobat								Туре а	question for	rhelp 👻 🗕 🗗	×
Image:																
Ind       I D       B / U       E = E = E       B & C × , M        M        D       P        R       D       P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P        P <       P        P <       P        P <					2 • <u>(C</u> Z * A *		- w -									
No       A       -10.03         No       A       No       P       B       S       provide number of the second	Arial		• 10 • B <i>I</i> <u>U</u>		€%,™	% €₽€₽ ⊞▼										
N9       X       1       N       N       N       P       R       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N       N																
A       B       D       B       L       J       K       L       M       NA       D       P       0       R       S       P         B       Constraint       District       Distric       Distric <thdistrict< th="">       Dis</thdistrict<>		N9	<b>▼</b> <i>f</i> <sub>*</sub> -10	03												
Image: section         Description         Description <thdescription< th=""></thdescription<>	A 1	В	C D	E F G H		J	K	L	M	N	0	Р	Q	R S	T Dripparu reserve	
Berge here         Duebels Dow         M 2-burl 02 2500 / AUTCHED         Autor 02 2500 / AUTCHED         Autor 02 2500 / AUTCHED         Description         Description </td <td>2</td> <td>retrieval</td> <td>filter</td> <td>Date Pd</td> <td>start</td> <td>exe time</td> <td>authorised</td> <td>authorised time</td> <td>status \$</td> <td>USEP</td> <td>Req</td> <td>Cleared</td> <td>Deficit Los</td> <td>ssMW Excess</td> <td>reqd c</td> <td>alı.</td>	2	retrieval	filter	Date Pd	start	exe time	authorised	authorised time	status \$	USEP	Req	Cleared	Deficit Los	ssMW Excess	reqd c	alı.
Image:	3	Energy, Reserves	Authorised Only	M 25-Jan-04 1	24-Jan-04 23:55:02	24-Jan-04 23:55:02	AUTHORISED	24-Jan-04 23:58:02	PASS	\$58.48	2985.802	2998.774	0	12.972 0	215.326	-
Image:	4	Versions	L'Estest Unity	M 25-Jan-04 2 M 25-Jan-04 3	25-Jan-04 00:25:02 25-Jan-04 00:55:03	25-Jan-04 00:25:02 25-Jan-04 00:55:03	AUTHORISED	25-Jan-04 00:28:01 25-Jan-04 00:58:01	PASS	\$58.47	2900.721	2912.892	0	12.171 0	216.442	*
Image: Solution List       M.S. Submedti S. S. Submedti S.	6	Risk Factors	Sunday	M 25-Jan-04 4	25-Jan-04 01:25:03	25-Jan-04 01:25:03	AUTHORISED	25-Jan-04 01:28:01	PASS	\$0.00	2809.645	2821.134	Ō	11.489 0	209.618	7
	7	SNKO cleared	Solution List	M 25-Jan-04 5	25-Jan-04 01:55:02	25-Jan-04 01:55:02	AUTHORISED	25-Jan-04 01:58:01	PASS	-\$0.09	2766.854	2780.387	0	13.533 0	210.665	1
	8	Replaced MVAr	A D YD TD	M 25-Jan-U4 6	25-Jan-04 02:25:03	25-Jan-04 02:25:03		25-Jan-04 02:28:04	PASS	-\$10.01	2723.863	2740.318	U	16.455 U	210.199	
1       Un too:       1       S-An-04       195       An-04	10	dau	25-Jan-2004	M 25-Jan-04 8	25-Jan-04 03:25:03	25-Jan-04 03:25:03		25-Jan-04 03:28:02	PASS	-\$0.03	2680.391	2696 118	0	15,727 (	202 575	2
c       database       backer       M. 25-Jun040 102 52 Jun040 102 502 Zi-Jun040 142500 Zi-Jun040 142	11	run type	DPR	M 25-Jan-04 9	25-Jan-04 03:55:03	25-Jan-04 03:55:03	AUTHORISED	25-Jan-04 03:58:02	PASS	-\$0.01	2668.189	2681.95	0	13.761 0	202.729	2
3       Status Courts       M. 2-Marriel M. 2014 M. 2012       2-Marriel M. 2010 PA25       8100       2714 M. 2010 PA25       9100       2214 M. 0       0       2243 M. 0       0       2049 M. 2010 PA25       9100       2714 M. 2010 PA25       9100 PA25       9100       2714 M. 2010 PA25       9100 PA25       9000 PA25	12	database	EMCP	M 25-Jan-04 10	25-Jan-04 04:25:02	25-Jan-04 04:25:02	AUTHORISED	25-Jan-04 04:28:01	PASS	-\$0.01	2671.723	2683.377	0	11.654 0	199.214	
Image:       Mit Schurdt B	13		Status Counts	M 25-Jan-04 11 M 25-Jan-04 12	25-Jan-04 04:55:02 25-Jan-04 05:25:02	25-Jan-04 04:55:02 25-Jan-04 05:25:02		25-Jan-04 04:58:01 25- Jan-04 05:28:02	PASS	\$0.00	2691.335	2703.999	0	12.664 U	1 202.365	2
Is       Jour Mit Schundt	15		Outages	M 25-Jan-04 13	25-Jan-04 05:55:02	25-Jan-04 05:55:02	AUTHORISED	25-Jan-04 05:58:01	PASS	\$0.00	2743.783	2754.533	Ő	10.75 0	197.91	
Image: Interance MM compare Bits + NMN Prices       But + NMN Prices       Bits + N	16		-	M 25-Jan-04 14	25-Jan-04 06:25:03	25-Jan-04 06:25:03	AUTHORISED	25-Jan-04 06:28:01	PASS	\$0.00	2769.433	2780.641	0	11.208 0	200.932	2
Image: Stand Processing       Ø Supple       M. Z. Supple       J. Z. Supple	1/	tolerance	Bus + MNN Prices	M 25-Jan-04 15 M 25-Jan-04 16	25-Jan-04 06:55:02 25-Jan-04 07:25:02	25-Jan-04 06:55:02 25-Jan-04 07:25:02	AUTHORISED	25-Jan-04 06:58:05 25-Jan-04 07:28:02	PASS	\$0.01	2792.355	2803.53	0	11.611 0	200.587	4
20       0.002       25-Jan-04 18       25-Jan-04 08 25 02       25-Jan-04 08 25 02       300 568       302 35       0       12.72       0       22.827       2         22       25-Jan-04 18       25-Jan-04 08 550       25-Jan-04 08 500 7 JASS 58 07       300 558       302 35       0       12.72       0       22.827       2         23       25-Jan-04 18       25-Jan-04 08 550       25-Jan-04 08 500 7 JASS 58 07       300 558       302 35       0       12.72       0       22.827       2         24       25-Jan-04 12 500       25-Jan-04 08 500 7 JASS 58 59       300 550       302 35       0       12.72       0       22.827       2         24       25-Jan-04 10 550 7 JAH-04 08 550 7 JAH-04 08 500 7 JAH-04 58       32.467 40 12.800 7 JASS 58 27       323.83 08 00       15.075       0       23.303         25       JAH 10 550 7 JAH-04 10 550 7 JAH-04 10 150 7 JAH-	19	MW compare	Sort by price	M 25-Jan-04 17	25-Jan-04 07:55:02	25-Jan-04 07:55:02	AUTHORISED	25-Jan-04 07:58:02	PASS	\$58.47	2912.062	2924.278	Ŭ	12.216 0	216.272	
22       mice compare       addominitions	20	0.002	Breach Elaws	M 25-Jan-04 18	25-Jan-04 08:25:02	25-Jan-04 08:25:02	AUTHORISED	25-Jan-04 08:28:01	PASS	\$59.55	3010.568	3023.35	0	12.782 0	216.287	-
23 <ul> <li>25-lay-04 025 00</li> <li>25-lay-04 025 00</li></ul>	21	Price compare	Branch Flows	M 25-Jan-04 19 M 25-Jan-04 20	25-Jan-04 08:55:02 25-Jan-04 09:25:02	25-Jan-04 08:55:02 25-Jan-04 09:25:02		25-Jan-04 08:58:01 25-Jan-04 09:28:01	PASS	\$60.57	3089.65	3103.141	0	13.491 U	232.704	2
24       Computer Num Fig.       Gen Scheduled       M. 25-Jann-04 122       25-Jann-04 10250       25-Jann-04 10	23	20.000	Sort by Branch Name	M 25-Jan-04 21	25-Jan-04 09:55:03	25-Jan-04 09:55:03	AUTHORISED	25-Jan-04 09:58:01	PASS	\$64.77	3223.269	3237.967	0	14.698 0	251.57	-
	24	Compare Next Pd	Gen Scheduled	M 25-Jan-04 22	25-Jan-04 10:25:02	25-Jan-04 10:25:02	AUTHORISED	25-Jan-04 10:28:01	PASS	\$64.87	3253.332	3268.407	0	15.075 0	253.03	Į.
27       12       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32       32 <t< td=""><td>25</td><td></td><td>Share DEL Facilities</td><td>M 25-Jan-04 23 M 25-Jan-04 24</td><td>25-Jan-04 10:55:03 25- Jan-04 11:25:02</td><td>25-Jan-04 10:55:03 25- Jan-04 11:25:03</td><td></td><td>25-Jan-04 10:58:02 25-Jan-04 11:28:02</td><td>PASS</td><td>\$64.57</td><td>3254.073</td><td>3259.063</td><td>0</td><td>14.99 U</td><td>261.522</td><td>-</td></t<>	25		Share DEL Facilities	M 25-Jan-04 23 M 25-Jan-04 24	25-Jan-04 10:55:03 25- Jan-04 11:25:02	25-Jan-04 10:55:03 25- Jan-04 11:25:03		25-Jan-04 10:58:02 25-Jan-04 11:28:02	PASS	\$64.57	3254.073	3259.063	0	14.99 U	261.522	-
28       Price Stack       Mi 25-Jan-04 12: 52 (2-5-Jan-04	27		E anow by a racing	M 25-Jan-04 25	25-Jan-04 11:55:02	25-Jan-04 11:55:02	AUTHORISED	25-Jan-04 11:58:03	PASS	\$62.71	3230.182	3245.014	0	14.832 0	261.040	
23       33       34       25-Jan-04 125 (2)       25-Jan-04 15 (2)       25-Jan-04	28		Price Stack	M 25-Jan-04 26	25-Jan-04 12:25:02	25-Jan-04 12:25:02	AUTHORISED	25-Jan-04 12:28:01	PASS	\$62.72	3234.854	3249.85	0	14.996 0	261.075	1
31       yepots       32.3-ye-04 135 00 2.5-lay-04 125 00 2.5-lay-04 1	29			M 25-Jan-04 27	25-Jan-04 12:55:02	25-Jan-04 12:55:02 25- Jan-04 13:25:03		25-Jan-04 12:58:01 25- Jan-04 13:28:02	PASS	\$62.71	3241.956	3256.863	0	14.907 C	261.047	-
22       general even       Bula Prices US       Mil 25-Jan-04 182 (25-Jan-04 1850)       25-Jan-04 1750)       <	31	reports		M 25-Jan-04 29	25-Jan-04 13:55:03	25-Jan-04 13:55:03	AUTHORISED	25-Jan-04 13:58:02	PASS	\$64.59	3245.619	3260.663	0	15.044 0	261.701	-
33       that em       Solution Summary       All PCF Data       Solution PCF Data	32	(these create	Bus Prices USV	M 25-Jan-04 30	25-Jan-04 14:25:02	25-Jan-04 14:25:02	AUTHORISED	25-Jan-04 14:28:02	PASS	\$64.49	3238.75	3253.758	0	15.008 0	261.803	
36       Mill PCF Data       Mill Scharr64 33       25-Janr64 85803 AUTHORISED       25-Janr64 15803 AUTHORISED       25-	33	their own	Solution Summary	M 25-Jan-04 31 M 25-Jan-04 32	25-Jan-04 14:55:03	25-Jan-04 14:55:03 25- Jan-04 15:25:02		25-Jan-04 14:58:01 25-Jan-04 15:28:01	PASS	\$64.77	3221.186	3235.894	0	14.708 U	255.774	2
36       Mi 25-Jann-04 125 (2)       25-Jann-04 152 (2)       25-Jann-04 152 (2)       312 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (2)       318 (	35	spreadsneed	All PCE Data	M 25-Jan-04 33	25-Jan-04 15:55:03	25-Jan-04 15:55:03	AUTHORISED	25-Jan-04 15:58:02	PASS	\$62.67	3189.224	3203.598	0	14.374 0	256.248	2
2/3       warnings_DAB_WAR       WAR       2>-Jan-04 18 550 375 - 017 425       52-Jan-04 17 520 2       2>-Jan-04 17 520 2	36			M 25-Jan-04 34	25-Jan-04 16:25:03	25-Jan-04 16:25:03	AUTHORISED	25-Jan-04 16:28:01	PASS	\$62.67	3182.52	3196.974	0	14.454 0	256.35	
33       WAR       W	37	warnin		M 25-Jan-04 35 M 25-Jan-04 36	25-Jan-04 16:55:03	25-Jan-04 16:55:03 25- Jan-04 17:25:02		25-Jan-04 16:58:01 25- Jan-04 17:28:01	PASS	\$62.67	3181.6	3195.986	0	14.386 U	256.363	2
40       Forecast Chart       Mi 25-Jan-04 182       25-Jan-04 18220       25-Jan-04 18250       25-Jan-04 12500       25-Jan-04 12	39	war in i	9° DAN WAN	M 25-Jan-04 37	25-Jan-04 17:55:03	25-Jan-04 17:55:03	AUTHORISED	25-Jan-04 17:58:02	PASS	\$64.78	3210.933	3225.696	0	14.763 0	255.928	2
1       42       Gen Connectivity       Check USEP       M       25-Jan-04 1850 (2)       25-Jan-04 1250 (2)	40	EGO	Forecast Chart	M 25-Jan-04 38	25-Jan-04 18:25:02	25-Jan-04 18:25:02	AUTHORISED	25-Jan-04 18:28:01	PASS	\$65.00	3304.066	3319.588	0	15.522 0	262.828	2
43       Caleboard	41	Gon Connectivity	Check LICER	M 25-Jan-04 39 M 25-Jan-04 40	25-Jan-04 18:55:02 25-Jan-04 19:25:03	25-Jan-04 18:55:02 25-Jan-04 19:25:03		25-Jan-04 18:58:02 25-Jan-04 19:28:01	PASS	\$65.77	3421.159	3437.557	0	17 216 0	266.409	4
44       Forecast Gan       Direck LPFs       Mi 25-Jan-04 2028 (2:5-Jan-04 2028 (2:2-Jan-04 208 (2:2-Jan-04 208 (2:2-Jan-04 208 (2:2-	43	Geniconnectivity		M 25-Jan-04 41	25-Jan-04 19:55:02	25-Jan-04 19:55:02	AUTHORISED	25-Jan-04 19:58:02	PASS	\$69.88	3506.106	3523.156	0	17.05 0	268.118	-
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Taking Period 7 as an example, when the lowest price was observed, the dispatch results were as follows:

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It was the unit ENV : TUASSTH : GENR1 that set the marginal price at (-\$10/MWh).



The message log for this period said that NPL was observed and four iterations were conducted as a result.

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7 01/25/2004 2:55:02 AM I Run ID D1AF12E0A6074A97E030330A010AFDB6	-
01/25/2004 2:55:02 AM I Starting Market Clearing Run, PLSQL procedure nem\$mc_runs.start_MC_run, concurrent Y	
9 01/25/2004 2:55:02 AM I Submitting BEGIN nemSmc_runs start_MC_run('DPR', trunc(get_next_period), date_to_period(get_next_period), trunc(get_next_period), date_to_period	
U (get_next_period), 'M', 0, 'N', mull, 'automatic run', 'D1AF12E0A6014A9FE030330A010AFDB6'); END;	
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13 01/2/2004 2/2/20 AM 1 Redues to start solver sent to ducte NEMA AC _ MC_RON_INT_O, parameters, DTAF 12DA00/AA9/1203050A010AP/D60EMCP	
<ul> <li>61/25/2004 2:55/32 AM 1 Batch not Market Cleaning Kull, FLSQE procedure inemand_runs.start_MC_run, concurrent 1 completed in 57 seconds</li> <li>10/25/2004 2:55/32 AM 1 Satur Averaging Kull, FLSQE procedure inemand_runs.start_MC_run, concurrent 1 completed in 57 seconds</li> </ul>	
16 01/25/0014 25:503 AM Host EMCPMC11	
77 01/25/2004 2:55:04 AM I Jan 25:P7: Processing period 2004-Jan -25:P7	
19 01/25/2004 2:55:07 AM I Jan 25:P7:: No current loading available for SCADA unit INTERTIE : SCADA : ONE	
20 01/25/2004 2:55:21 AM I Jan 25:P7:1:No observed reactive power flow available for 2 branches	
21 01/25/2004 2:55:21 AM I Jan25:P7:1::Constraint INTERTIE_INPUT_LIMIT references unit not in LP	
23 01/25/2004 2:55:21 AM I Jan25:P7:1::Constraint INTERTIE_OUTPUT_LIMIT' references branch not in LP	
24 01/25/2004 2:55:23 AM I Jan25:P7:1::Solution exhibits non-physical losses, SysError=89.5	
Contraction of the second seco	
27 01/25/2004 2:55:23 AM I Jan25/P / 2::Constraint 'INTEKTIE_INPUT_LIBIL' reterences unit not in LP	
28 01/22/2004 2:57:23 AM 11an252 P./2::Constraint TN TEKTIE_001P01_LIMIT references branch not in LP	
23 01/22/2004 2.52.24 AM 1 all/22 / 22.50m/01 exmosts non-physical tosses, system or -0.04	
3 01/25/2004 2:52:25 AM Jan 25P7:3 Constraint INTERITE INPUT LIMIT references unit not in LP	
32 01/25/2004 2:55:25 AM I Jan25:P7:3::Constraint 'INTERTIE OUTPUT LIMIT' references branch not in LP	
34 01/25/2004 2:55:26 AM I Jan25:P7:3::Solution exhibits non-physical losses, SysError=27.0	
35 01/25/2004 2:55:26 AM I Jan25:P74::No observed reactive power flow available for 2 branches	
01/25/2004 2:55:26 AM I Jan25:P74::Constraint INTERTIE_INPUT_LIMIT references unit not in LP	
38 01/25/2004 2:55:26 AM I Jan25:P74::Constraint 'INTERTIE_OUTPUT_LIMIT' references branch not in LP	
39 01/25/2004 2:55:27 AMI Jan25P7:4: Ignoring non-physical losses within tolerance, SysError=6.4	
U1/25/2004 2:57:55 AM I Starting Advisory Creation	
42 01/22/2004 2:5/55 4X 11 Finishing Advisory Ureanon 42 01/22/2004 2:5/55 4X 10 Englished National National Sector Sector Sector	
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The iterations stopped at the fourth round, because the SysError went below 10MW, which was the pre-defined threshold. Despite that, Period 7 was still observed to have the highest transmission loss on the day, due to the non physical loss.

#### 3.3 Conclusion

With four iterations in this real-time dispatch run of the case study, the solver took about 33 seconds to complete. Compared with the 22 seconds taken by the DPR for Period 11 when only a single iteration was required, the performance of the solver was still comparable. Hence, there may be an incentive to further lower the threshold if NPL is triggered frequently.



## 4.0 Recommendation

With the current occurrence of NPL as 0.03% to date<sup>3</sup> (as of 31 July 2004), it is not cost effective to adjust the threshold value, taking into consideration the resources needed for User Acceptance Testing in both IT and Market Operations. However, should the NPL occurrence increase above 0.3%, i.e., to an average of once a week, it would trigger a proposal to update the SysError parameter so as to achieve a more accurate result.

<sup>&</sup>lt;sup>3</sup> The occurrences of NPL since the market started on 1 January 2003:

 <sup>3</sup> January 2003, Period 10 ~ 11

<sup>• 25</sup> January 2004, Period 5 ~ 10



## Glossary

LP, linear programming MCE, market clearing engine The software used in the NEMS to discover dispatch schedule and prices.

*NEMS, National Electricity Market of Singapore* The Singapore electricity market.

NPL, non-physical loss



## Appendix A Market Rules

The Market Rules has a dedicated section for the handling of NPL, as extracted below:

#### Section D: Post-processing

#### D.22 Loss Calculation Correction

- D.22.1 The procedure set out in this section D.22 shall be carried out whenever the conditions specified in section D.22.2 apply, except in the cases described in sections D.22.1 to D.22.13.
  - D.22.1.1 If the value of SysError calculated in accordance with section D.22.4 is less than the system loss error tolerance established by the *EMC* pursuant to section D.22.2, then the *EMC* may accept the current linear program solution and use the results for the *dispatch period* in the relevant *real-time dispatch schedule*, *short-term schedule*, *pre-dispatch schedule* or *market outlook scenario*.
  - D.22.1.2 If the number of repetitions of the procedures in this section D.22, in respect of a particular *dispatch period* and particular *real-time dispatch schedule* is equal to the maximum number of iterations for the loss calculation correction established by the *EMC* pursuant to section D.22.2, then the *EMC* may halt the process and the provisions of Chapter 5 section 9.1.2.2 and Chapter 6 section 9.3.2B shall apply.

Explanatory note: This is the case where the market clearing engine has failed to find a

correct solution within the allotted time, and the incorrect solution is not good enough to send

to the AGC system. Instead the PSO will manually dispatch the power system, and the

prices will be calculated ex-post by the EMC, which will have more time for the MCE to run to

an acceptable solution.

- D.22.1.3 If the number of repetitions of the procedures in this section D.22, in respect of a particular *dispatch period* and particular *short-term schedule*, *pre-dispatch schedule* or *market outlook scenario*, is equal to the maximum number of iterations for the loss calculation correction established by the *EMC* pursuant to section D.22.2, then the *EMC* may accept the current linear program solution and use the results in the relevant *short-term schedule*, *pre-dispatch schedule* or *market outlook* scenario.
- D.22.1.4 The *EMC* shall establish and *publish*, prior to the *market commencement date*, and may thereafter from time to time update and re-*publish* as required, values for the system loss error tolerance and maximum number of iterations for the loss calculation correction.



- D.22.1.5 If any of the violation variables ExcessLineFlowForward<sub>k</sub>, ExcessLineFlowReverse<sub>k</sub>, DeficitLineFlowWeight<sub>k</sub>, or ExcessLineFlowWeight<sub>k</sub> has a value greater than zero then the *EMC* need not carry out the procedures in this section D.22.
- D.22.2 After each solution of the linear program specified in section C, the variables Weight<sub>k,j</sub> will be examined. Subject to section D.22.1, if the condition in section D.22.2.1 is false for any of the pairs of non-adjacent weights on a single *dispatch network line*, then sections D.22.3 to D.22.5 shall apply.

 $\{k, j, i \mid j, i \in \text{DISCRSUB}_k, \text{ where } k \in \text{LINES}, i > j + 1\}$ 

D.22.3 The total erroneous losses in the solution are calculated by the following formulae:

$$\begin{aligned} \text{ActualLoss}_{k} &= \text{LineLossCast}_{k,i} \\ &+ \frac{\text{LineFlow}_{k} - \text{LineFlowCast}_{k,i}}{\text{LineFlowCast}_{k,i+1} - \text{LineFlowCast}_{k,i}} \\ &\times (\text{LineLossCast}_{k,i+1} - \text{LineLossCast}_{k,i}) \end{aligned}$$

$$CircuitError_{k} = LineLoss_{k} - ActualLoss_{k}$$

 $\begin{cases} i, k/i \in \text{DISCRSUB}_k, \text{ where } k \in \text{LINES}, \\ i = \text{Max} \begin{pmatrix} j/j < N(\text{DISCRSUB}_k), \\ \text{LineFlowConst}_{k,j} \le \text{LineFlow}_k \end{pmatrix} \end{cases}$ 

$$SysError = \sum_{k \in LINES} CircuitError_k$$

D.22.4 The set  $DISCRSUB_k$  shall be redefined for each line in the dispatch network. For each  $k \in LINES$ , the outer points of the line loss function in the forward and reverse directions shall be adjusted in the following manner:

D.22.4.1 Forward direction limit:

 $\{i/i \in \text{DISCRSUB}_k, \text{ where } k \in \text{LINES}, i = \text{Max}(j/\text{LineFlowConst}_{k,j} < \text{LineFlow}_k + \text{SysError})\}$ If *i* is the final point, then the forward direction limits shall not be adjusted,

Otherwise:

Discard  $j \in \text{DISCRSUB}_k$  where j > i



Define new values:

LineLossConst<sub>k i+1</sub> = LineLossConst<sub>k</sub> +  $\frac{\text{LineFlow}_{k} + \text{SysError} - \text{LineFlowConst}_{k,i}}{\text{LineFlowConst}_{k,i+1} - \text{LineFlowConst}_{k,i}}$  $\times$  (LineLossConst<sub>k i+1</sub> – LineLossConst<sub>k i</sub>)

 $LineFlowConst_{k,i+1} = LineFlow_k + SysError$ 

where:

LineFlowConst<sub>k,i+1</sub> and LineLossConst<sub>k,i+1</sub>, where they appear in the right hand side of the first equation, refer to values from the linear program that has just been solved, whereas the parameters on the left hand side of the two equations refer to new values of the these parameters.

#### D.22.4.2 Reversedirection limit:

 $\{i/i \in \text{DISCRSUB}_k, \text{ where } k \in \text{LINES}, i = \text{Min}(j/\text{LineFlowConst}_{k,i} > \text{LineFlow}_k - \text{SysError})\}$ If *i* is the first point, then the reverse direction limits shall not be adjusted,

Otherwise:

Discard  $j \in \text{DISCRSUB}_k$  where j < i

Define new values:

LineLossConst<sub>k i-1</sub> =

LineLossConst<sub>ki</sub>

 $\frac{\text{LineFlow}_{k} - \text{SysError} - \text{LineFlowConst}_{k,i}}{\text{LineFlowConst}_{k,i-1} - \text{LineFlowConst}_{k,i}} -$ 

 $\times$  (LineLossConst<sub>ki-1</sub> – LineLossConst<sub>ki</sub>)

LineFlowConst<sub>k i-1</sub> = LineFlow<sub>k</sub> - SysError

where:

LineFlowConst<sub>k.i-1</sub> and LineLossConst<sub>k.i-1</sub>, where they appear in the right hand side of the first equation, refer to values from the linear program that has just been solved, whereas the parameters on the left hand side of the two equations refer to new values of the these parameters.

D.22.5 Following the calculation of input data described in sections D.22.2 to D.22.4, the linear programme described in section C shall be resolved.