NIAGARA-ON-THE-LAKE HYDRO

DISTRIBUTION SYSTEM PLAN

APPENDIX

C

IESO Letter of Comment

Niagara-on-the-Lake Hydro

Renewable Energy Generation Investments Plan

August 20, 2018

Independent Electricity System Operator

Introduction

On March 28, 2013, the Ontario Energy Board ("the OEB" or "Board") issued its Filing Requirements for Electricity Transmission and Distribution Applications; Chapter 5 – Consolidated Distribution System Plan Filing Requirements (EB-2010-0377). Chapter 5 implements the Board's policy direction on 'an integrated approach to distribution network planning', outlined in the Board's October 18, 2012 Report of the Board - A Renewed Regulatory Framework for Electricity Distributors: A Performance Based Approach.

As outlined in the Chapter 5 filing requirements, the Board expects that the Ontario Power Authority[1] ("OPA") comment letter will include:

- the applications it has received from renewable generators through the FIT program for connection in the distributor's service area;
- whether the distributor has consulted with the OPA, or participated in planning meetings with the OPA;
- the potential need for co-ordination with other distributors and/or transmitters or others on implementing elements of the REG investments; and
- whether the REG investments proposed in the DS Plan are consistent with any Regional Infrastructure Plan.

Niagara-On-The-Lake Hydro – Distribution System Plan

On August 8, 2018 Niagara-On-The-Lake Hydro ("NOTL") provided Renewable Energy Generation information ("Plan") to the IESO[2] as part of its 5-year Distribution System Plan. The IESO has reviewed NOTL's Plan and has provided its comments below.

OPA FIT/microFIT Applications Received

According to the IESO's information, as of June 30, 2018, the IESO has offered contracts to 146 microFIT projects representing a total capacity of 1.30 MW. The IESO has also offered contracts to 12 FIT projects representing a total capacity of 1.75 MW. Other renewable generation projects identified are 2 RESOP projects connected to NOTL's distribution system representing 2.35 MW of capacity. The data provided by NOTL is reasonably consistent with the IESO's information.

[1] On January 1, 2015, the Ontario Power Authority ("OPA") merged with the Independent Electricity System Operator ("IESO") to create a new organization that will combine the OPA and IESO mandates. The new organization is called the Independent Electricity System Operator.
[2] Ibid.

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Consultation / Participation in Planning Meetings; Coordination with Distributors / Transmitters / Others; Consistency with Regional Plans

The IESO notes that NOTL is part of the Niagara Region which consists of the City of Port Colborne, City of Welland, City of Thorold, City of Niagara Falls, Town of Niagara on the Lake, City of St Catherines, Town of Fort Erie, Town of Lincoln, Township of West Lincoln, Town of Grimsby, Township of Wainfleet, Town of Pelham and portions of Haldimand County. A summary of the Niagara Regional Planning Process of which NOTL was a participant is as follows:

Hydro One Transmission Inc., the transmitter for the region, completed the Needs Screening process in in April of 2016.[3] The Needs Screening process found there were no needs that required regional coordination. Hydro One's subsequent Regional Infrastructure Plan ("RIP") completed March 28, 2017 provide a summary of the wires investments required for the area for sustainment purposes or as outcomes of local planning and concluded the regional planning process for this planning cycle.[4]

Niagara-on-the-Lake and the IESO have therefore not yet participated in planning meetings beyond the Needs Assessment and the RIP.

The information provided by NOTL to the IESO shows that there are no major REG investments required to connect REG capacity expected over the Plan period. Therefore due to non-relevance, the IESO has no comment on the following two items as outlined in the Chapter 5 filing requirements, specifically:

- the potential need for co-ordination with other distributors and/or transmitters or others on implementing elements of the REG investments; and
- whether the REG investments proposed in the DS Plan are consistent with any Regional Infrastructure Plan.

The Regional Planning process for this region is now complete for this planning cycle. It will begin again within the five-year time frame (2021) unless there is sufficient load growth or a trigger event that requires it to begin earlier.

The IESO looks forward to working with NOTL on regional planning once that process is triggered for its service area, and appreciates the opportunity to comment on the information provided as part of its Distribution System Plan at this time.

[3] Hydro One Networks Inc., April 23, 2016, Needs Assessment Report: https://www.hydroone.com/abouthydroone/CorporateInformation/regionalplans/niagara/Documents/Needs%20Assessment%20Report%20-%20%20Niagara.pdf

[4] Hydro One Networks Inc., March 28, 2018, Regional Infrastructure Plan: https://www.hydroone.com/abouthydroone/CorporateInformation/regionalplans/niagara/Documents/Niagara%20RIP%20Report.pdf

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NIAGARA-ON-THE-LAKE HYDRO

DISTRIBUTION SYSTEM PLAN

APPENDIX

D

Health & Safety Program Evaluation Report

The evaluation visits were held on June 5, 2018. Additional discussion and information exchange subsequently occurred as a follow up to the facility visit and direct meetings with staff.
The Health & Safety Program Evaluation Report was completed and submitted on June 28, 2018.

Program Evaluation Conducted by:

Denise Pockele, CRSP, Pockele & Associates Inc.

Persons Contacted:

Tim Curtis, President
Kazi Marouf, VP Operations
Craig McLean, Line Superintendent
John Beam, Journeyman/Lineman, Lead
Sara Engels, Manager, Corporate Services, member of JHSC
Jennifer Grebenc, Customer Account Representative, member of JHSC
Randy Kent, Health & Safety Consultant

Background & Purpose:

The objective of the health and safety program evaluation is to identify strengths and needs of Niagara-on-the-Lake Hydro Inc.'s health and safety program. Elements of the health and safety program were evaluated against the following legislation, standards and best practices:

- Ontario's Occupational Health & Safety Act and Regulations
- Ministry of Labour Guidelines and Codes of Practice
- Workplace Safety & Insurance Act
- First Aid Regulation
- Relevant codes, guidelines, and standards
- Workwell Health & Safety Evaluation Tool
- IHSA's Certificate of Recognition (COR) Evaluation Tool

ELEMENT 1-HEALTH & SAFETY POLICY

Does the employer have a policy that:

Element #	Description	Guideline	Requirements met? Y/N	Strengths	Needs	Verification Technique	Recommendations
1.1	Is signed by the president, CEO or local senior management?	The policy statement should be signed by the president or CEO of the organization, or the senior most leader of the local operation.	Y	The policy statement is signed.		Documentation	
1.2	Includes management's commitment to provide a safe and healthy work environment?	The Policy Statement must include senior management's commitment to provide a safe work environment and a work environment that promotes occupational health.	Y	The commitment s of senior management, the Board, and the JHSC, are included.		Documentation	
1.3	Recognizes the right of workers to work in a safe and healthy work environment?	The Policy Statement must clearly state that management (CEO, president, etc.) recognizes that all workers have the right to work in a safe and healthy workplace.	Y	The policy reflects the right to a safe and healthy workplace.		Documentation	
1.4	Is current?	The Policy Statement shall indicate its date of issuance.	Y	The policy is current, and dated for 2018.		Documentation	
1.5	Is reviewed annually?	The review shall be conducted by senior management at least annually and records of the review shall be retained.	Y	The policy is reviewed annually, and includes health and safety program implementation and management goals and objectives.		Documentation	
1.6	Is visibly posted or made available to workers	The Policy Statement must be posted in the workplace. It may be provided to workers in the form of a handbook, safety manual, as part of a procedures manual, or in electronic form. A workplace can also include traveling, working at client premises or working at home.	Y	The policy statement is posted on the health and safety board, and is available on the shared drive.		Observation or interview	
1.7	Addresses health and safety responsibilities for all workplace parties?	Policy statement must make all workplace parties aware of their individual OH&S obligations, and make reference to documented OH&S responsibilities of workplace parties that are consistent with legislated requirements.	Y	The policy statement includes all relevant workplace parties and their OH&S legal and regulatory responsibilities.		Documentation and interview	

1.8	Expresses a commitment to work in a spirit of consultation and co-operation with workers?	The Policy Statement should outline the commitment of the company to work jointly with relevant personnel in the development and implementation of their H & S program.	Y	The policy statement contains the commitment to work jointly towards a strong Internal Responsibility System. It includes the active participation of the JHSC.		Documentation	
1.9	Is understood by personnel?	Verify that workers understand what the policy says.	Y	Staff who were contacted exhibited a good understanding of the health and safety policy and its guiding principles.		Interview	

ELEMENT 2 HAZARD ASSESSMENT ANALYSIS & CONTROL

Element #	Description	Guideline	Requirement met? Y/N	Strength	Need	Verification Technique	Recommendations
2.1	Are hazard assessments conducted, documented and approved for all operations?	A documented procedure must be in place to ensure hazard assessments are conducted for all operations and activities. Verify that hazard assessments are being performed according to the procedure.	Partial	Hazard assessments have been conducted for workplace violence and confined spaces. The job planning and tailboard conference process is used to assess and document hazards for operations crews working on external job sites. An Arc Flash Assessment was completed on May 29, 2015 for the purpose of assessing a potential arc flash hazard within GPI's distribution system.	EHS-P11 Job Hazard & Task Analysis procedure describes the process for completion of hazard assessments for all jobs; however, all jobs and tasks have not been assessed in documented form in accordance with the procedure.	Documentation	Complete hazard assessments for all jobs and tasks. Develop and implement a procedure to describe current site-specific Job Planning and Tailboard meeting activities, and cross-reference the required forms that are in use.
2.2	Are hazard assessments maintained?	Documented hazard assessments must be updated to reflect process changes, and re-approved as appropriate. Ongoing hazard assessments could include introduction of new activities, materials,	Partial	The job planning and tailboard conference process satisfies the requirement for ongoing hazard assessment on a daily basis and are based on the specific work activities being	EHS-P11 Job Hazard & Task Analysis procedure describes the process for ongoing maintenance and updating of the hazard assessments as well as review every 3 years.	Documentation	See above comments. Develop and implement a process for regular review and updating of the hazard assessments once they've been initially completed.

		equipment, emergency operations, etc.		performed.			
2.3	Are appropriate personnel involved in the hazard assessment process?	Hazard assessments must be conducted using a team-based approach. Relevant participants can include workers, supervisors, technical, engineering, maintenance, management, suppliers, etc.	Partial	Job planning and tailboard hazard assessments use a team-based approach because the entire crew is involved.	Staff and JHSC engagement in all aspects of the health and safety program is evident. These individuals will be actively involved in the development and implementation of job hazard assessments.	Documentation and Interview	Involvement of staff and the JHSC is a critical component of development and implementation of the job hazard assessments for all jobs and tasks.
2.4	Are workplace and job specific hazards clearly identified in the job hazard assessment documents?	The assessment shall identify the hazards in the workplace and include physical and other agents such as temperature, vibration, noise, UV, radiation, dust, chemical, ergonomic, biological and other health and safety hazards.	Partial	EHS-P11 Job Hazard & Task Analysis procedure describes and defines the various categories of hazards that must be considered. The job planning and tailboard conference process accurately identifies workplace and job-specific hazards.	If utilized as written, EHS-P11 will meet the requirements of this element.	Documentation	When completing the job hazard assessments, follow the requirements of EHS-P11.
2.5	Are identified hazards prioritized by risk, potential for severity and frequency?	The hazard assessment document must use a standardized methodology for prioritizing the risks associated with the identified hazards. A risk threshold level shall be established and documented.	Partial	The job planning and tailboard conference process does not currently use a risk rating or priority-based methodology. EHS-P11 Job Hazard & Task Analysis procedure includes a standardized methodology for hazard classification. The Loss Potential Analysis process used to investigate accidents and incidents utilizes a different risk rating	If utilized as written, EHS-P11 will meet the requirements of this element.	Documentation	Utilize the risk rating/hazard classification methodology specified in the procedure, or alternatively, use the Loss Potential Analysis risk rating system for the job hazard assessments. If the Loss Analysis risk rating system is utilized, then revise EHS-P11 to include the Loss Potential Analysis risk rating system instead of the methodology described in EHS-P11. This will provide a single risk rating system that can be used for all hazard assessment activities.

				system.			
2.6	Is there a list of identified critical tasks?	The organization shall document and communicate the activities that are associated with risks above the threshold value.	N		Once the hazard assessments have been completed, a hazard registry can be developed which lists identified critical tasks.	Documentation	Once the revised job-specific hazard assessments have been completed, a list of critical tasks should be developed.
2.7	Are controls developed for all identified hazards?	Documented control strategies (procedures, standards, checklists, supervision, monitoring, JHA, JSA, etc.) shall exist for all hazards.	Partial	A number of documented procedures and SWPs have been developed to describe and define hazard controls for identified hazards. The SWPs are referred to on the Job Planning and Tailboard Conference form, and are located in binders on each truck.	Documented procedures for all hazards have not been completed (e.g. ladder safety, fuel dispensing, storage and use of propane, PPE, working at heights, confined space program, etc.)	Documentation	Review, revise, and develop comprehensive procedures, safe work practices and other documentation to accurately reflect all hazard controls. The newly-developed job hazard assessments should cross-reference applicable SWPs and procedures.
2.8	Are controls implemented in a timely manner?	Verify that actions have been taken to mitigate identified hazards.	Partial	Hazard controls are well-implemented in a timely manner. The Job Planning and Tailboard Conference process includes timely implementation of necessary controls.	Documented policies, procedures, and practices either do not comprehensively describe all hazard controls that are actually in place, or there is no documentation at all to reflect the policies, procedures, and practices that are actually being practised.	Documentation and Observation	Review, revise, and develop comprehensive procedures, safe work practices and other documentation to accurately reflect all hazard controls. Ensure that hazard control procedures are reviewed, revised, and updated as needed.
2.9	Are appropriate personnel informed of the control strategies?	Records of communication and/or training on controls should be retained and show that controls have been developed and deployed, and identify the participants in this communication.	Partial	Staff training and meetings are used to inform affected staff of hazard controls. Staff exhibit a thorough understanding of hazard controls.	Documented policies, procedures and practices have not been developed for all hazard controls that are actively in use at this time.	Documentation and Interview	As new procedures are developed, continue to communicate these to staff through safety meetings and training sessions.

2.10	Does management support the process of ongoing hazard assessments?	Hazard assessment and risk reduction activities shall be supported by management. Evidence can include documented review, assignment of resources to this activity, involvement in developing risk mitigation controls, timely approvals of requested modifications to processes, equipment, procedures, etc. and review of the results of any actions.	Y	A commitment to supporting on-going hazard assessment is evident, and is reflected in EHS-P11. Staff share the commitment to ongoing hazard assessment. Management conducts site visits, workplace inspections, safety meetings, and other communication methods in order to support ongoing hazard assessment and related actions.		Documentation and Interview	
2.11	Does the company have a process for evaluating and monitoring contractors and subcontractors?	Criteria for selection, evaluation, and re-evaluation shall be established. Records of evaluation results and any necessary actions arising from the evaluation shall be maintained. This process may include reviewing incident reports, clearance certificates, performance reports, orientation records, internal feedback, complaints, assessments, etc.	Partial	EHS-P20-Contractor Health and Safety Policy describes contractor safety requirements. Contractor performance is carefully evaluated prior to selecting the contractor, as well throughout the duration of the contract.	The contractor safety program does not include provisions for completion of the WSIB Independent Operator questionnaire. Application of the Contractor Health and Safety Policy to all contracted work (e.g. HVAC, plumbing, electrical, fleet maintenance, etc.) is not done in all cases of contracted work.	Documentation	Include a process for completion of the WSIB Independent Operator Questionnaire for independent operator/contractors. Expand the contractor safety program to include all contractors providing services at NOTL Hydro facilities (e.g. HVAC, plumbing, electrical, fleet maintenance.)

ELEMENT 3-SAFE WORK PRACTICES

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
3.1	Have safe work practices been documented?	Verify that applicable safe work practices are documented and approved.	Partial	Safe work practices specified in the IHSA's Safe Practice Guides and the Electrical Utility Safety Rules are followed. A number of safe work practices are documented and include: • Re-energizing transformer after blown fuse • Performing work in single phase meters • Installing grounds for bracket grounding • Boom inspection and holding valve check • Temporary support of pole • Pole climbing • Inspecting rubber cover-voltages up to 28 KV • Opening cut-out using load break switch • Setting poles in live line • Leakage test on aerial device above 15 KV • Connecting new underground services • Pole pulling using RBD and pole jack • Insulator change using a jib • Installing in-line switches mid span or with anti-rotation bars • Installing and removing transformers	Safe work practices do not accurately reflect all identified hazard controls. Hazard controls are in place, but are not all documented. Some examples of additionally-required safe work practices include: • Confined space entry program • Traffic control • Use of utility work protection code • Application and variance from Electrical Utility Safety Rules • Hydrovac bonding and grounding • Trenching and excavations • Portable generators • Ladder safety • Working at heights • PPE • Lockout and energy control • Fuel safety • Housekeeping • Slip, trip, and fall prevention • Arc flash assessment and control • Driving safety • Cold stress • Stinging and biting insects • Noxious plants	Documentation	Develop and implement safe work practices that adequately and accurately reflect all hazards affecting staff including, but not limited to the following examples: • Confined space entry program • Traffic control • Use of utility work protection code • Application and variance from Electrical Utility Safety Rules • Hydrovac bonding and grounding • Trenching and excavations • Portable generators • Ladder safety • Working at heights • PPE • Lockout and energy control • Fuel safety • Housekeeping • Slip, trip, and fall prevention • Arc flash assessment and control • Driving safety • Cold stress • Stinging and biting insects • Noxious plants • Office safety • Office ergonomics • Manual material

				using aerial device • Changing dead end insulators • Installing spider ropes in preparation for tension stringing • Installing conductor by tension stringing pulling end • Installing conductor by tension stringing tensioner end • Safe operation of RBD • Primary and secondary isolation for customers • Installing or removing pad mounted transformers, switch gear, junction boxes from service • Removing transformers from poles using transformer davit and sheave blocks • Forklift procedure and roles • Loading poles onto extended pole trailer • Removing rubber gloves for specific jobs • Underground secondary splices and alterations to secondary services • Job work using an aerial device • Switching operations • Bench grinder procedure and rules • Chainsaw procedure and rules • Oil spill response: field version • Heat stress • Hantavirus • Stringing at NOTLH	• Office safety • Office ergonomics • Manual material handling		handling

3.2	Do safe work practices accurately reflect the organization's activities?	Review the hazard assessments and conduct site observations and then ascertain if safe work practices exists.	Partial	See above comments.	Hazard assessments for all work activities and jobs haven't been completed, as described in element 2. Also see above comments.	Documentation and Observation	See above comments.
3.3	Are the safe work practices understood by workers?	Verify through personal interviews that workers do understand the company's safe work practices and can describe them?	Y	Staff exhibit a thorough understand of safe work practices.		Interview	Continue with training and communication initiatives that reinforce safe work practices. When newly-documented safe work practices are developed, continue with current methods utilized to communicate and train affected staff (safety meetings, training sessions, etc.)
3.4	Are they readily available to workers?	Verify that documented safe work practices are available at all workplaces and located where workers have easy access to them.	Y	SWPs are readily available to workers in print and electronic formats. Each truck has a binder which contains copies of relevant SWPs.		Observation or Interview	Newly-developed SWPs will likely be distributed and communicated using the current and effective methods which are in place.
3.5	Are they followed by workers on a regular basis?	Assess the workplace to determine if safe work practices are being followed consistently by all workers.	Y	Safe work practices appear to be followed consistently. Although a crew visit could not be done owing to time constraints, evidence clearly suggests that staff adhere to SWPs. Site visits are regularly completed by management and supervision, which are effective methods of verifying that workers follow safe work practices.		Observation or Interview	
3.6	Do both management and workers participate in the development and review of safe work practices?	When drafting safe work practices, include input from those who will actually be doing and/or supervising the work. Inputs may include orientation, committee meetings and tool box talks.	Y	Management, supervision, and workers actively participate in the development and review of safe work practices. The health and safety consultant is also instrumental in developing and revising SWPs in consultation with staff and the JHSC. The JHSC actively participates in the development and review of safe work practices.		Interview	

ELEMENT 4-SAFE WORK PROCEDURES

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
4.1	Have safe job procedures been documented?	Verify that applicable safe job procedures are documented and approved.	Partial	Safe job procedures are listed during the job planning and tailboard conference. Safe job procedures specified in the IHSA's Safe Practice Guides and the Electrical Utilities Rule Book are followed by Operations staff. A comprehensive list of blended safe work practices and safe job procedures is provided in element 3.1 above.	Safe job procedures do not accurately reflect all identified hazard controls. Additional identified safe job procedures may be blended with those listed above in element 3.1 above.	Documentation	Develop and implement approved safe work job procedures that adequately and accurately reflect all hazards affecting staff. Refer to recommendations provided above in element 3.1.
4.2	Do the safe job procedures accurately reflect the organization's activities?	Review the hazard assessments, incident reports and conduct site observations and then ascertain if appropriate safe job procedures exist. At a minimum, safe job procedures should be developed for all high risk activities.	Partial	See above comments.	See above comments.	Documentation and Observation	See above comments.
4.3	Are the procedures understood by workers?	Verify that workers understand the safe job procedures and can describe them.	Y	Safe job procedures are an integral part of day to day work activities and operations, despite the fact that not all procedures are documented. Staff exhibit a thorough understanding of the need for, and use of safe job procedures. Site visits are regularly completed by management and supervision, and the health and safety consultant, which are effective methods of verifying that workers follow safe job procedures.		Interview	

4.4	Are safe job procedures readily available to workers?	Verify that documented safe job procedures are available at all workplaces and are located where workers have easy access to them.	Y	Safe job procedures (reflected in SWPs) are readily available to workers in print and electronic formats. Each truck has a binder which contains copies of relevant SWPs. Staff have access to the Electrical Utilities Rule Book, Safe Practice Guides, and the Utility Work Protection Code to provide further guidance in relation to safe job procedures.		Observation or Interview	Ensure that all newly-issued safe job procedures are readily available to all affected staff.
4.5	Are the safe job procedures followed on a regular basis?	Assess multiple workers to determine if safe job procedures are being followed consistently by all workers. Assess compliance with procedure by observing the actual practice.	Y	Safe job procedures are being followed consistently. The site visit process is an excellent method of verifying that workers follow safe job procedures.		Observation or Interview	
4.6	Do both management and workers participate in the development/review of the procedures?	When drafting safe job procedures, it is important to include input from those people that will actually be doing and/or supervising the work. Possible inputs can include orientation, health and safely meetings and review of safe job procedures by the JHSC.	Y	Management, supervision, the JHSC, and workers actively participate in the development and review of safe job procedures. The health and safety consultant is also instrumental in developing and revising procedures in consultation with staff and the JHSC.		Interview	

ELEMENT 5-COMPANY HEALTH & SAFETY RULES

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
5.1	Are company rules clearly stated in writing?	Verify that the company rules have been documented.	Partial	Health and safety rules pertaining to hazard reporting and leadership are reflected in procedures.	Health and safety rules are definitely understood and practiced; however, there did not appear to be a comprehensive documented summary of the organization's safety rules.	Documentation	Develop a written procedure which summarizes safety rules and responsibilities.
5.2	Are the rules prominently posted or provided to each employee?	Verify by observation or interview that rules are posted in high traffic areas. Records should show that employees have been made aware of the rules.	Partial	EHS procedures are available to all staff on the server, and in the H & S procedure binder.	See above.	Observation or interview	When documented health and safety rules are completed, staff review of the summary of rules should be completed.
5.3	Do workers understand company and workplace-specific rules?	Verify through interviews that employees are aware of and understand the company rules.	Y	Employees are well aware of, and familiar with the guiding principles and safety rules, despite the fact that these aren't captured in a single documented list or set of rules.		Interview	
5.4	Do the rules include a progressive disciplinary policy?	Ensure there is a progressive disciplinary policy included in the company rules.	N	Progressive discipline measures are in place, and implemented where necessary.	There did not appear to be a documented progressive discipline policy for health and safety infractions.	Documentation	Develop and implement a progressive discipline policy/procedure for health and safety infractions.
5.5	Are the rules applied/enforced consistently throughout the company?	Company rules should be consistently enforced in all divisions, departments and areas of the organization.	Y	The active involvement of management, supervision, and individual staff is evident, and demonstrates that health and safety is consistently enforced and reinforced throughout all divisions and departments. Site visits are an effective method of ensuring that company rules are consistently enforced in Operations.		Documentation and interview.	

ELEMENT 6-PERSONAL PROTECTIVE EQUIPMENT

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
6.1	Is there a written policy governing mandatory use of PPE where required?	Verify that a written policy exists.	Partial	Mandatory PPE measures are in place. The Utility Rule Book specifies use of PPE, as well as the IHSA's Safe Practice Guides. The SWPs make reference to requirements for PPE (e.g. Chainsaw, Bench Grinder, etc.)	There is no written policy or procedure that defines and describes all PPE requirements and practices. EHS-18 Noise Assessment Policy describes hearing protection requirements.	Documentation	Develop and implement a written PPE procedure that defines and describes the selection, fit, care, use, and replacement of all PPE required. Ensure that the SWPs specify the exact type of PPE that must be worn when performing various job tasks.
6.2	Are there specific criteria used to select PPE?	Verify that the organization reviews SDSs, hazard assessments, legislation, etc. to determine proper selection of PPE.	Y	Appropriate criteria, based on hazards and worker exposures are considered when selecting and determining PPE needs.		Documentation	
6.3	Has the organization documented the required PPE for all activities?	The organization will need to assess the exposure to workplace hazards and determine the appropriate PPE. Also, the organization will need to adhere to any regulatory requirements.	Partial	The SWPs make reference to requirements for PPE. General requirements for Arc Flash PPE are described in several of the SWPs. The Job Plan and Tailboard form references PPE required for the job underway.	General reference to wearing PPE is made in several SWPs; however, the SWP's do not specify the exact types of PPE that must be used in the specific work activity or job task.	Documentation	See comments above element 6.1.
6.4	Are workers made aware of the requirements for PPE for specific tasks?	Worker training records should be reviewed to ensure that PPE requirements have been addressed. Training records can include orientation training, site training, department training, job specific training, procedures or work instruction training.	Y	Workers are trained on the selection, fit, care, and use of required PPE. Specific training on fire retardant clothing, fall protection, rubber gloves, etc. has been done.		Documentation	Revised PPE procedures should be reviewed with all affected staff once they are completed.

6.5	Are there written rules and/or guidelines for the proper fitting, care and use of specialized PPE?	Verify that written guidelines for specialized PPE are readily available.	N	Manufacturer and other guidelines are followed for the selection, fitting, care and use of specialized PPE (e.g. rubber gloves, Arc Flash PPE, harnesses, lanyards) and records are kept of testing and inspection activities.	Specialized PPE guidelines are followed; however the written procedures or guidelines do not comprehensively reflect all activities relating to the proper fit, care and use of specialized PPE.	Documentation	Develop written rules and guidelines that accurately describe how specialized PPE is fitted, maintained, inspected, and used. Include who is responsible, the schedule for maintenance and inspections, as well as reference to relevant records and documentation.
6.6	Is adequate specialized PPE provided and made available to workers for specific activities?	Verify that specialized PPE (respirators, rubber gloves, arc flash PPE, fall arrest harnesses, etc.) is provided by the company and made available.	Y	Specialized PPE is provided and made available. Examples include fall arrest equipment, arc flash clothing, high visibility clothing, rubber gloves, chainsaw PPE.)		Observation or Interview	
6.7	Is proper training provided for workers required to use specialized PPE?	Review worker orientation and training records to verify that specialized PPE training is being done.	Partial	Proper training is provided and documentation is retained. Examples include Ministry of Labour Working at Heights training and laundering of arc flash clothing.	There is no procedure that accurately describes responsibilities for PPE training that includes content, frequency, etc.	Documentation and Interview	When revising procedures (see comments in element 6.1) ensure that an accurate description of training requirements is included.
6.8	Is there a system in place to regularly inspect and maintain specialized PPE?	Check for PPE inspection schedule to ensure that manufacturer's or legislated requirements are being met.	Y	Manufacturer and legislated requirement are met. Documentation is maintained for rubber goods inspection and testing, and for fall protection equipment. Staff perform visual pre-use inspection of their PPE including lanyards, harnesses, gloves, etc.		Documentation	
6.9	Do management, supervisors, workers and sub-contractors use required PPE?	Verify by observation that all parties have, and are using appropriate PPE.	Y	Site visits are conducted to verify that PPE is being used. Staff were observed to be using required PPE.		Observation	

ELEMENT 7-MAINTENANCE, TOOLS, EQUIPMENT & VEHICLES

Does the company's preventative maintenance program for facilities, tools, equipment, and vehicles include:

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
7.1	An inventory of items to be maintained?	A list of tools, equipment (SCBA, tripod, eyewash, CO monitors, lathes, presses, skid steers, lift trucks), vehicles, facilities, job trailers, maintenance shop, etc.)	Partial	A comprehensive inventory of Operations equipment is maintained by the Line Superintendent using a hard copy filing system for individual vehicles, tools, and equipment. Records of maintenance provide a working inventory of facility-related maintenance items. EHS-P17 procedure describes the general principles of preventive maintenance.	An all-encompassing list of equipment and facility components that are included in the preventive maintenance program was not available. EHS-P17 does not accurately describe and define the various roles and responsibilities for preventive maintenance that are currently in place.	Documentation	Develop a comprehensive spreadsheet or matrix describing equipment and facility items that are included in the preventive maintenance process. This will provide an enhanced method of capturing all activities, frequencies, due dates, reminders, etc. Revise EHS-P17 to accurately describe the various roles and responsibilities for administration of the preventive maintenance program.
7.2	The use of schedules and checklists as required?	A preventative maintenance program includes a system for scheduling and recording all maintenance work. Verify maintenance records/checklists.	Y	A variety of checklists and records are used to record inspections, checks, maintenance and servicing. Examples include emergency generator testing, pre-trip vehicle inspection, forklift maintenance and inspection, current leakage tests, rubber glove and rubber goods testing and inspection, safety harness and		Documentation	Cross-reference to appropriate schedules and checklists could be included in the spreadsheet or matrix described above.

				lanyard, etc. Scheduled inspection and maintenance activities are well documented in the individual files retained by the Line Superintendent.			
7.3	Provisions to ensure manufacturer's maintenance guidelines and/or regulatory standards are met?	Verify that maintenance is performed according to manufacturer's and/or legislated requirements.	Y	This is well managed and implemented.		Documentation and Interview	When developing the procedures to describe preventative maintenance activities, make reference to manufacturer guidelines and regulatory standards. This may be done by including a cross-reference to a manufacturer guideline or operating manual on the overall inventory list.
7.4	Is maintenance being performed as planned?	Verify maintenance records to ensure that maintenance is systematically scheduled and completed as required according to manufacturer's and/or legislated requirements.	Y	This is well managed and implemented.		Documentation	
7.5	Records stating corrective action taken?	Actions taken to correct identified equipment issues should be recorded on work orders, maintenance logs, or checklists.	Y	Records are kept to document corrective actions taken.		Documentation	
7.6	Does a competent/qualified worker perform the inspection and maintenance?	Training and qualification credentials must be supplied in order to fulfill the requirements of this question. Credentials may be a certificate of qualification, specific manufacturer's training in addition to years of experience.	Y	A combination of trained and qualified staff as well as qualified external service providers perform inspection and maintenance activities. Examples include vehicle and RBD inspection, testing, and maintenance.		Documentation	Develop written procedures to accurately define and describe competency and qualification standards .
7.7	A procedure to effectively remove overage and/or defective tools, equipment and vehicles from service?	A guideline for tagging and subsequent removal of overage or defective equipment/tools/vehicles/PPE must be in place and verifiable.	Partial	A procedure is in place to remove defective items.		Documentation and Interview	Develop and implement written procedures to accurately describe the process used for tagging out and/or removing defective items from service.

ELEMENT 8-TRAINING & COMMUNICATIONS

Element #	Description	Guideline	Require-ment met? Y/N	Strengths	Needs	Verification Technique	Recommendations
8.1	Does the organization have a documented orientation program?	Verify that a documented program includes all relevant aspects of the organization's health and safety program.	Y	EHS P04-New & Transferred Employee Orientation Training describes orientation training. Orientation training is completed as required. The Infuse on-line electrical utilities training program is also used for some training. External health and safety consultant and trainer provides in-house orientation sessions.	The procedure does not specify all relevant content that is included in the training, in particular the requirement specified in O. Reg. 297/13 Occupational Health and Safety Awareness & Training.	Documentation	Revise the procedure to include a description of the orientation training content, method s, and timelines for delivery.
8.2	Is orientation a mandatory requirement for all personnel?	Verify that orientation was conducted with all personnel upon joining the company, before they started work. This includes management, supervisors, worker, subcontractors, suppliers, etc.	Y	Generic documented orientation training is completed for newly-hired staff. It includes legal and regulatory compliance. Management and supervisory health and safety training is also completed. Orientation training is also provided to Operations contractors and subcontractors. The Infuse online training program is also used for some orientation training.		Documentation	
8.3	Is orientation standardized across the organization?	Verify there is a standard orientation form or equivalent is being used. Check orientation records.	Y	Health and safety orientation training is standardized and content is captured on the orientation form used by the external training provider. The Infuse System is also used for some online general orientation training.		Documentation	
8.4	Is there a provision for the signatures of both the worker and the person conducting the orientation?	Verify documentation that shows orientation has been provided, and that both the worker and the program facilitator have signed the orientation record.	Y	General health and safety orientation records indicate that both worker and facilitator have signed the orientation records.		Documentation	Expand the orientation program to ensure that all department-specific and on-the-job training content and co-signatures are accurately recorded.

8.5	Are orientation records maintained?	Verify that records of employee orientation are readily available.	Y	A revised training matrix has been developed and cross-references orientation training.		Documentation	
8.6	Are mandatory training requirements verified or training provided before starting work?	Verify that records show the organization's mandatory training, including legislated requirements have been identified and completed.	Y	Mandatory training requirements are provided within the first 2 weeks of hire. EHS-P-015 Employee Training describes training requirements, measures, and record-keeping.		Documentation	
8.7	Is job specific training provided and are records retained?	Verify that additional task/job specific training provided (other than mandatory training), such as procedures, work and workplace instruction.	Partial	On-the-job training is provided by department supervisors and by peers. Tailboard safety conferences are extensively used to conduct on-the job, and task specific training and coaching. Internally-delivered and externally-attended job specific training are provided. Examples include working at heights, Lineman Proficiency, Utility Work Protection, Traffic Control, Confined Space, etc.	Job-specific orientation training includes on-the-job mentoring and orientation, as well as review of department specific training content. These activities aren't comprehensive captured in a checklist or other record that clearly illustrates training topics that are covered by supervisors and through peer training.	Documentation and Interview	Once a system for capturing department-specific and job-specific training is implemented, include these training sessions and activities in the training matrix.
8.8	Does a competent person provide/conduct job specific training?	Verify that the training is done by a "competent person" (as defined under the OHSA). Trainer qualifications can include education such as a trade certificate, or degree, years of relevant experience, skill in teaching, training certificates.)	Y	Internally-delivered and externally-delivered job-specific training are done by suitably qualified persons. The apprenticeship program includes a wide variety of job-specific training and coaching.		Documentation	
8.9	Have supervisors received training in workplace inspections and OH & S responsibilities?	Verify that the supervisor has completed the required training in OH&S responsibilities.	Partial	Supervisors and management have completed Awareness training, which covers OH&S Responsibilities.	Training records indicated that supervisors have not completed workplace inspection training.	Documentation	Provide training for supervisors on workplace inspections and site visits.
8.10	Is training understood by personnel and is it effective?	Verify that personnel understand the training received.	Y	Staff exhibit a high level of understanding of health and safety in daily work activities.		Interview and Documentation	
8.11	Does senior management of the organization hold scheduled health and safety meetings?	Verify that an annual schedule of health and safety events such as quarterly meetings, annual meetings, spring start-up meetings, summer barbeques exist.	Y	Senior management actively leads and participates in health and safety meetings. Senior management holds team meetings on a periodic basis during the year, which are scheduled.	There did not appear to be a procedure that describes the various health and safety meetings.	Documentation and Interview	Develop a procedure to describe meetings and staff communication methods in general terms, and describe responsibilities for holding meetings, staff attendance, meeting content, record-keeping, and methods to follow up on identified during

							meetings.
8.12	Does senior management attend/participate in health and safety meetings?	Verify through interviews and meeting minutes that discussions, Q & A sessions, etc. were held. When performing site visits, senior management also participate in the tailboard meetings with crew members.	Y	Senior management actively participates in departmental health and safety meetings.		Documentation and Interview	
8.13	Are records of safety meetings retained?	This includes meeting agendas, attendance list, minutes, and action items.	Y	Where appropriate, minutes and attendance are kept. Team meetings are not recorded, owing to the philosophy that discussion may be more open if minutes are not recorded. Action arising from these meetings is implemented and followed up. Departmental safety meetings are held monthly, and facilitated by an external trainer and consultant.		Documentation	
8.14	Does two way communication exist during these meetings?	What methods do managers use to involve employees in this communication?	Y	Active and open two-way communication occurs during meetings.		Documentation and Interview	
8.15	Are tailgate or tool box talks or their equivalent held as scheduled?	Verify records of these talks. Records should indicate the date, topic, attendees and facilitator and any resulting action items.	Y	Tailboard safety meetings are completed as required. Contractors and subcontractors are involved in tailboard meetings as well. In some cases, NOTL Hydro staff are included within contractor and subcontractor tailboards. Tailboard conference records are monitored and tracked by the Line Superintendent. Action items and hazard controls are recorded. Periodic safety talks involving inside/office staff occur as needed or form part of regular staff meetings.	There did not appear to be a procedure that describes the tailboard meeting process that is in place.	Documentation	Develop a procedure that defines and describes the requirements and process for conducting tailboard meetings.

ELEMENT 9-WORKPLACE INSPECTIONS

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
9.1	Does the organization have a documented workplace inspection policy?	Verify that the workplace inspection procedure includes all operations (office, shop, year, projects, etc.)	Partial	EHS-P16 –Planned Inspections describes workplace inspections procedures. Monthly workplace inspections are completed by the JHSC. Inspections and site visits are also scheduled and completed by management and supervision. Inspections and site visits are included in the annual H & S Goals.	The requirements for site visits are not defined and described in a procedure.	Documentation	Revise the existing Planned Inspections procedure, or create a new procedure to define and describe requirements for site visits and periodic management and supervisory inspections.
9.2	Does the procedure define the inspection frequencies and responsibilities?	The procedure must identify when inspections are to be completed and who must complete them. The frequencies defined must meet legislated requirements and manufacturer specification as a minimum. The responsibilities for reporting on finding and follow up shall also be defined.	Partial	Inspection frequencies and responsibilities are described in general terms. Staff are assigned job-specific and task-specific inspections that include pre-trip inspections of commercial vehicles, forklift, equipment pre-use inspections, truck inspections, rubber gloves, fall protection, etc. Inspection requirements are explained in some SWPs (e.g. forklift, rubber cover-up, RBD operation, etc.) Truck inspections are completed, a standardized form is used.	Site visit frequencies and responsibilities are not specifically defined and described in a procedure.	Documentation	Develop inspection and site visit procedures that define inspection frequencies and responsibilities. Include the use of relevant inspection and site visit forms that are currently utilized. Develop inspection procedures that define inspection requirements and responsibilities for job-specific and equipment-specific inspections that are required of staff. The inspection requirements could also be included in SWPs that describe equipment operation and use, or other related procedures.

9.3	Does the procedure define requirements for conducting and recording pre-use inspections of vehicles, machines, tools, and equipment?	Verify that the inspection procedure defines the pre-use inspection requirements for vehicles, machines, tools and equipment including those required by the manufacturers (Reg 213/91 section 93(3) and 94(1)(2).)	Partial	See comments above. Pre-use inspections are documented for forklifts, trucks, etc.	See comments above.	Documentation	Develop relevant procedures to accurately define requirements for conducting and recording pre-use inspections. See comments above.
9.4	Are there specific forms and checklists used for recording inspections?	Verify inspection checklists and forms • Are specific to the item(s) and workplace(s) • Include all parts of the workplace\include all legislated and manufacturer specified inspection requirements where applicable	Y	Forms and checklists are used for recording inspections. These include the Site Visits, monthly JHSC inspections, truck inspections, forklift inspections, etc.)		Documentation	Ensure that newly-developed procedures include cross-reference to relevant forms and checklists.
9.5	Do records indicate that these inspections have been completed as required?	Inspection records shall be retained and show that inspections have been performed and completed to legislated requirements.	Y	The Line Superintendent retains records of inspections and tracks the results, and performs periodic audits of the assigned pre-use and periodic equipment inspections.		Documentation	Newly-developed inspection procedures should include a description of responsibilities for maintenance and retention of inspection records.
9.6	Are assigned personnel performing inspections as required?	Review inspection records to verify that workplace parties are performing their assigned inspections.	Y	Job-specific and equipment-specific inspections are performed as required and tracked by the Line Supervisor. Inspections are completed by assigned staff, as well as by external inspection providers. JHSC monthly inspections are completed. The VP of Operations oversees the completion of inspection activities.		Documentation and Interview	
9.7	Are inspection frequencies being adhered to?	Review inspection records to verify that inspections are performed when required by legislation, when specified by the manufacturer and as required by the organization's HSMS.	Y	Inspection records indicate that inspections required by legislation, guidelines and manufacturer standards are adhered to.		Documentation	

9.8	Are workers involved in the inspection process?	Worker participation can include conducting the inspection, being involved in discussions during or following the inspection. Inspection records should indicate this involvement.	Y	JHSC inspections include contacting workers in the inspection process. Site visits include contact with crew members, contractors, and subcontractors.		Documentation and Interview	
9.9	Are identified deficiencies corrected in a timely manner?	Verify that corrective action taken is documented including who, what, and when.	Y	Deficiencies identified during site visits and inspections appear to be promptly corrected.		Documentation	Newly-developed inspection procedures should include a description of how deficiencies will be corrected.
9.10	Are the results of workplace inspections communicated to senior management?	Verify that senior management participates in the process by reviewing inspection reports, prioritizing actions to correct any identified deficiencies and providing resources as needed.	Y	Inspection results and action items are comprehensively overseen by senior management. The VP of Operations is involved in front-line inspection activities as well.		Documentation and Interview	Newly-developed inspection procedures should include a description of communication and distribution of inspection results.
9.11	Are inspection reports communicated to all relevant workplace parties?	The results of workplace inspections shall be communicated, either through posting, workplace discussions, or other means of communication to all workers, supervision, and management associated with the areas that were inspected.	Y	A robust system for communicating inspection results is in place and includes staff meetings, and postings, etc. JHSC inspection reports are well-communicated.		Interview	

ELEMENT 10-INVESTIGATIONS & REPORTING

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
10.1	Does the organization have a documented policy and procedure for the investigating and reporting of incidents that meets the legislated requirements?	The procedure shall describe the process for investigating and reporting incidents, including prescribed incidents, responsibilities, timelines, communication requirements, corrective actions and their effectiveness and the retention of records.	Partial	EHS-P03 Accident/Incident Reporting procedure describes a process for reporting incidents. The Loss Analysis Report is the basic tool used to capture the reporting of accidents and incidents.	The procedure does not comprehensively describe revised guidelines for occupational illness, critical injury reporting, nor does it describe the Construction Regulations requirements for reporting and notification. The procedure does not accurately describe the currently-used Loss Analysis Report process.	Documentation	Revise procedures to include all reporting requirements including prescribed incidents (critical injuries, occupational illness, electrical contact, cave-in, construction incidents, etc.) Responsibilities must be clearly described as well as timelines, communication requirements, internal communication requirements, corrective actions and records retention. Revise procedures to include a comprehensive description of how the Loss Analysis process is used.
10.2	Do records show that the incident investigation and reporting procedure is being followed?	Records of investigations shall demonstrate that incident investigations are being conducted as per the documented procedure.	Partial	The Loss Analysis Report contains detailed information about individual incidents and related investigation processes.	See above comments.	Documentation and Interview	See above comments.
10.3	Has the organization established a standardized incident investigation form that is readily available?	All areas of the organization shall use a common form to record incident investigations which shall be readily available to all personnel at all workplaces.	Y	The Loss Analysis report form is readily available, and is in use.		Documentation	The revised accident and incident investigation procedure should cross-reference the Loss Analysis Report.
10.4	Are workers aware of reporting	Verify by interview that workers are aware of and	Y	Incident report requirements are well		Interview	

	procedures?	understand the company's incident reporting procedures.		understood by staff. Near miss incidents are promptly reported.			
10.5	Have supervisors been trained in incident investigation and reporting procedures?	Verify training records and interview supervisors.	Y	Supervisors and managers have been trained on use of the Loss Analysis Report.		Documentation and Interview	Retraining of supervisors and managers may be required once the revised procedures have been implemented.
10.6	Are appropriate personnel involved in investigations?	Review investigation reports that indicate supervisors and workers (including the safety rep. or JHSC member if appropriate) are involved in investigations and that required personnel have signed the report.	Y	Appropriate personnel at all levels in the organization are actively involved in investigations. The safety consultant is also involved in the investigation process.		Documentation	
10.7	Are opportunities for corrective and preventive actions (CA&PA) being identified and addressed?	Verify that inspection reports, action plans, etc. contain evidence of proactive reporting, prioritizing incidents or other inputs into the preventive action process.	Y	Corrective and preventive actions are promptly identified and addressed. Senior management and staff are actively involved in addressing required actions and outcomes.		Documentation and Interview	
10.8	Are corrective and preventive actions implemented in a timely manner?	Records shall indicate that preventive actions are being implemented in a timely manner and their effectiveness assessed.	Y	Corrective and preventive actions are implemented in a timely and effective manner.		Documentation and Interview	
10.9	Are corrective actions communicated to workers?	Records shall show that the results of corrective and preventive actions to improve workplace health and safety have been communicated to workers. Communication can include posted materials, meeting minutes, tool box talks, safety meetings, etc.	Y	A robust system is in place to effectively communicate corrective and preventive actions to workers. Front-line staff are frequently involved in the communication of corrective actions.		Interview	
10.10	Is the organization measuring the effectiveness of the corrective and preventive actions?	Verify that management has reviewed the effectiveness of the corrective and preventive actions taken.	Y	Senior management leadership and involvement includes evaluation of the effectiveness of corrective and preventive actions.		Documentation	

ELEMENT 11-EMERGENCY PREPAREDNESS

Have appropriate emergency response resources and equipment been made available including:

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
11.1	Do documented emergency preparedness and Emergency Response Plans (ERP) include the most appropriate responses to identified hazards and address the potential for emergency situations?	The plans for potential situations such as fire, powerline contact, medical, vehicle or equipment incidents, etc. shall be documented and communicated for the workplace.	Y	A fire safety plan has been completed and approved by the chief fire prevention official. Measures and procedures are in place for May Day incidents, electrical contact, bucket evacuation, bucket rescue, bucket transfer, PCBs and oil spills, falls using fall arrest, pole rescue, etc. All trucks contain binders with emergency procedures.		Documentation and Observation	
11.2	Do the plans include the input and approval of relevant interested parties?	The ERP for all organizations within the scope of the employer (subcontractors, clients, emergency services, neighbours) should be approved by senior management both initially and when there is a change in scope.	Y	The fire safety plan was approved by senior management and included senior management involvement in its development. The JHSC and safety consultant are also involved in development of emergency procedures and plans.		Documentation	

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
11.3	Do the plans define the roles and responsibilities of relevant personnel, and include training in emergency procedures?	Verify training records to determine that employees involved in emergency response (rescuers, responders, fire marshals, etc.) are appropriately trained and that records of training are maintained.	Y	The fire safety plan defines roles, responsibilities of relevant personnel, including training requirements. Training and drills have been completed. Training and re-training of Operations staff in pole rescue, May Day, bucket rescue, bucket evacuation and transfer, fall arrest, etc. are completed and records are maintained. Emergency fire and evacuation drills have been done in the past and records are kept. Office staff have undergone a mock Mayday emergency exercise. This activity led to fine-tuning emergency response to a Mayday call. Staff provided valuable feedback and comments which led to improvements.		Documentation and Interview	
11.4	Is an appropriate emergency communication system in place?	This could include reporting the emergency to a central location and the use of alarm bell, radio or telephone to warn all employees of the emergency.	Y	Appropriate means of communication are used in the facility, as well as for crew emergencies.		Documentation and interview	
11.5	Has the plan been tested for deficiencies and corrective action taken (if necessary)?	Testing procedures can include exercises such as fire drills, mock evacuations, demonstrations with fire extinguishers, etc. Reports on the results of the exercises must be available for review.	Y	Evacuation drills for the facility have been done. Practical exercises are included in training for bucket and pole rescue, working at heights, and Mayday. Plans are in place for training on robbery prevention and emergencies with the police.		Documentation	
11.6	Are the appropriate number and type of fire extinguishers at marked locations?	The workplace or site plan should include the specifications, type, size and rating and locations of fire extinguishers and equipment.	Y	The facility Fire Safety Plan includes floor plans, and identified fire extinguisher locations. Vehicles are provided with fire extinguishers.		Documentation and observation	
11.7	Are workers who are required to use fire extinguishers trained how to use them?	Verify that workers are trained and that training records are maintained.	Y	Fire extinguisher training has been completed for all staff.		Documentation	
11.8	Are fire extinguishers regularly inspected and maintained?	Verify that a competent worker inspects every fire extinguisher	Y	Fire extinguishers are inspected and maintained according to the		Documentation and observation	

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
		for defects and deterioration at least once a month. A log noting the date of inspection must be attached to the extinguisher.		Fire Code.			
11.9	Is all other emergency response equipment regularly inspected and maintained?	Verify that equipment such as AED, rescue ladders, breathing apparatus, etc. are inspected and maintained according to manufacturer's requirements.	Y	Confined space rescue equipment, bucket rescue equipment, eyewash stations are regularly inspected and properly maintained.		Documentation	
11.10	First aid station/facilities and supplies?	In the workplace verify there are sufficient first aid stations/facilities and that they contain the proper first aid supplies as per the first aid regulations.	Y	More than the minimum requirements for first aid stations have been provided.		Observation	
11.11	Qualified first aid personnel?	Verify that first aiders are qualified to the required standard Emergency First Aid or Standard First Aid. Look for posted certificates or names of first aiders.	Partial	All staff are appropriately first aid qualified.	First aid certificates or names should be posted.	Documentation or observation	First aid certificates and/or names should be posted.
11.12	Provision for transporting an injured worker to a hospital or medical facility.	Verify that a vehicle or process for ambulance is available at all times for transporting an injured worker to a medical facility.	Y	Provisions for transporting of an injured worker are in place.		Observation and interview	

ELEMENT 12-STATISTICS & RECORDS

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
12.1	Is there a documented procedure to organize, monitor, and measure OH&S performance?	Measures can include both quantitative and qualitative components, be proactive and/or reactive, show the extent to which OH&S objectives are met, as well as the effectiveness of controls.	Partial	Measures are in place to effectively organize, monitor and measure health and safety performance. Senior management is actively involved in ensuring objectives are met. The safety consultant and the JHSC are also involved in ensuring goals are met, and the effectiveness of the program. EHS-P00 Environment Health & Safety Policy describes the H & S Program goals, and EHS-P01-Leadership and Administration further describes oversight of OH&S performance.	The current procedures do not fully describe and reflect the various methods used to organize, monitor, and measure OH&S performance.	Documentation	The procedure should provide more definition and detail regarding how the HSMS will be organized, monitored, and measured.
12.2	Are corporate and/or project health and safety summaries developed and maintained?	Project reports should be readily available for the auditor. Monthly reports should roll the statistics from all projects into a corporate document. The annual report should be an overall report on health and safety activities and statistics for the year. Activity summaries should be available for each project and for the company: e.g. toolbox talks, training and worker orientation records, injury and accident investigation reports, insurance claims, etc.	Y	Crew site visits are well documented and completed. The President and VP of Operations provide reports to the Board relating to health and safety activities and statistics. This is done on a periodic basis, and as needs. Statistics and summaries can be produced as needed.		Documentation	
12.3	Is OH&S	Statistical reports shall be generated on a	Partial	Annual health and	Formalized	Documentation	Consider establishing

	performance being measured at a specified frequency?	regular basis and readily available, and include individual projects and the company as a whole.		safety goals include measurement of performance in achieving the goals.	statistical reports are not generated on a regular basis; however, relevant consideration of OH&S performance is being measured.		specified frequencies for review and documenting these activities. This is a critical component if the company wishes to pursue a formal accreditation (e.g. C.O.R., OHSAS 18001, or CSA Z1000.)
12.4	Does the company compare their health and safety performance with past performance?	Year-to-year comparisons should be done to evaluate performance and the effectiveness of any efforts to improve performance.	Y	Year-to-year comparisons are considered, and impact the goal setting for the subsequent year.	See comments above.	Documentation	
12.5	Are the annual statistics analyzed and needs or trends identified?	Analysis verification could include minutes, trend analysis, corrective action plans which identify areas such as: • Particular areas where training is needed • Where equipment should be repaired or replaced • Where a safe work practice should be developed • Where a specific job task analysis should be undertaken	Y	This H & S Program Evaluation may be used to assist in further development of this element.		Documentation	The results of this report, as well as the extent to which the 2018 H & S goals have been achieved will provide core statistics and measurables.
12.6	Are first aid treatment records analyzed?	Analysis verification could include first aid treatment records, minutes, trend analysis, corrective action plans.	Y	First aid incidents are considered when conducting the Loss Analysis investigation.		Documentation	
12.7	Was an action plan developed based on the summary and recommendations of your last audit?	Verify that an action plan was defined as a result of the prior (COR or other recognized OH&SM) audit report. This should be part of the organization's corrective and preventive action system.	Y	Niagara-on-the-Lake Hydro participated in the Zero Quest program, and attained the Platinum Level award in 2011. Since that time, action plans and annual goal setting activities have been implemented. The 2018 goals included completion of an external evaluation/audit of the health and safety program.	Identified needs from this H & S Program Evaluation will be provided.	Documentation	Develop an action plan based on the identified needs and recommendations of this Health & Safety Program Evaluation.
12.8	Was the action plan communicated to workers and implemented in a timely manner?	Verify how the action plan was communicated to workers. E.g. minutes, memo, tool box talk, etc. Review the action plan to verify that recommendations have been implemented.	Y	Extensive staff involvement and engagement has been undertaken by the management team		Documentation	

				when developing and implementing health and safety program action plans.			

ELEMENT 13-LEGISLATION

Element #	Description	Guideline	Requirement Met? Y/N	Strengths	Needs	Verification Technique	Recommendations

Element #	Description	Guideline	Requirement Met? Y/N	Strengths	Needs	Verification Technique	Recommendations
13.1	Is health and safety legislation (all acts and regulations that apply) considered during the job planning process?	Verify that the organization has ensured that all applicable acts and regulations are considered when planning and executing the work.	Y	Legal and regulatory requirements are considered in job planning and when executing work activities. Contracted and subcontracted work and related activities are also extensively reviewed to ensure conformance with all legal and regulatory requirements.		Documentation and Interview	
13.2	Are copies of relevant legislation readily available at each workplace as required?	Verify that appropriate and current legislation (OHSA, Construction Regs, Industrial Regs, WHMIS, etc.) are readily available to workers and/or posted in the workplace.	Y	The OHSA, regulations, information guides and posters are readily available. IHSA Safe Practice Guides and the Electrical Utilities Rule Book and Utility Work Protection Code are available.		Observation or Interview	
13.3	Have supervisors been trained on their rights and responsibilities and how to exercise them?	Verify that records of training on OH&S responsibilities are available. Verify by interview that supervisors are aware of those responsibilities.	Y	Management and supervision have been trained.		Documentation and Interview	
13.4	Have workers been trained on their rights and responsibilities and how to exercise them?	Verify that records of training on OH&S rights and responsibilities are available. Verify by interview that workers are aware of their rights and responsibilities.	Y	Workers have been trained on legal and regulatory responsibilities. Records are kept.		Documentations and Interview	
13.5	Are legislated posting requirements being met?	Verify by observation that required documents are posted in the workplace (WSIB form 82, Notice of Project, MOL prevention poster, first aid certificates, JHSC members, worker trades committee members, etc.)	Y	All required postings are in place. Notice of Project is available on site as needed.	Discussed the completion and availability of the Form 1000 Registration for construction projects in cases where NOTL Hydro is deemed the constructor, and situations when a third party is the constructor, and NOTL Hydro is an employer on the constructor's project.	Observation	Ensure that the Form 1000 Registration is completed and is provided to, or obtained from the constructor as appropriate. The completed forms must also be kept at the construction project for the duration of work.

ELEMENT 14-OCCUPATIONAL HEALTH

Element #	Description	Guideline	Requirement Met? Y/N	Strengths	Needs	Verification Technique	Recommendations
14.1	Has the organization conducted a risk assessment for occupational health hazards?	Risks associated with identified occupational health hazards should be identified, prioritized, and documented.	Partial	The job planning process includes an assessment of occupational health hazards. Health hazards have been considered when developing safe work practices and procedures.	More detailed job hazard assessments were identified as a need in element 2.	Documentation	Provide a more detailed risk assessment of occupational illness and health hazards when the job hazard assessments are revised and expanded.
14.2	Have controls been developed and implemented for identified occupational health hazards?	Controls to mitigate the risks should be developed. Controls can include elimination, substitution, engineering controls, signage/warnings/administrative controls, PPE, etc.	Partial	Controls have been developed and implemented for occupational health hazards. Some SWPs address health hazards such as heat stress and noise.	The controls that are implemented to control health hazards are not all reflected in documented procedures.	Documentation	Develop documented procedures and safe work practices that include all occupational health hazard control measures (e.g. exposure to biting/stinging insects, noxious plants, blood/body fluids, UV, cold stress, etc.)
14.3	Is there a documented procedure that addresses working safely with chemicals?	A chemical inventory and procedures for safe handling, use, storage, clean-up and transportation are required. This may include designated substances.	Partial	An inventory of WHMIS-controlled hazardous materials is completed. A procedure is in place for testing of transformer oil for the presence of PCBs.	Specific procedures (other than information contained in Safety Data Sheets and labels) that detail the safe handling, use, storage, clean-up and transportation of hazardous materials are not all documented.	Documentation	Develop documented procedures and safe work practices for the safe handling, use, storage, clean-up and transportation of hazardous materials (e.g. fuels, hydraulic and other fluids, propane, etc.)
14.4	Is there a documented procedure that	Physical agents include temperature hazards (extreme heat and cold), vibration, noise, UV exposure and	Partial	EHS-P18-Noise Assessment Policy describes noise	Specific documented procedures have not been completed for	Documentation	Develop written procedures that are specific to the workplace for the physical

	addresses working safely with physical agents?	radiation exposure.		surveys and related measures to control exposure to noise. SWP-P36-Heat Stress Response Plan describes controls for exposure to heat.	hazards such as cold exposure, vibration, UV exposure.) The Noise Assessment Policy refers to an exposure table that is not contained in Ontario's Noise Regulation.		agents to which staff are exposed. Revise EHS-P18 to refer to Ontario's Noise Regulation and related requirements.
14.5	Is there a documented procedure that addresses working safely with biological agents?	Human biological wastes, sharps, bird, bat or other animal droppings, dead animals, poisonous insects, reptiles and plants.	Partial	SWP-037 Hantavirus procedure has been developed and documented. Measures and procedures are implemented when dealing with biological agents (e.g. noxious plants, stinging insects, ticks, west nile virus, animals, etc.)	The measures and procedures are not comprehensively documented.	Documentation.	Develop written procedures that are specific to the workplace for the identified biological agents to which staff are exposed.
14.6	Is there a documented procedure that addresses working safely with lead?	Lead may be in paints, solder, batteries, electronics, etc.	N/A			Documentation.	Lead is reportedly not present in the workplace.
14.7	Is there a documented procedure that addresses working safely with asbestos?	Asbestos may be encountered during building retrofit work and may involve asbestos removal or work that may disturb asbestos-containing materials, including insulation.	N/A			Documentation.	At this time, asbestos has not been identified in any of the facilities.
14.8	Is there a documented procedure that addresses working safely with silica?	Silica is a designated substance that is found in sandblasting, building restoration, quarries, concrete, etc.	Partial	Cutting concrete may expose workers to silica dust. This is infrequently done, and dust masks are provided as needed.		Documentation.	When developing the PPE procedure, reference to use of the dust mask for concrete dust exposure or other dust exposures should be made.
14.9	Is there a documented procedure for chemical spills clean-up?	Verify that the procedure identifies methods to safely respond to spills.	Partial	SWP-036 Oil Spill Response procedure has been completed.	Documented procedures for spills of fuel and other chemicals are not completed.	Documentation and Interview	Develop spills clean up procedure to include fuels, hydraulic fluids, and other chemical materials used in the facility or by crews. Include fuel used for portable electrical generators.
14.10	Is there a documented	The procedure should include information for monitoring hazardous materials.	N	Safety Data Sheets are readily available.	Specific procedures (other than information	Documentation.	Develop procedures for the proper storage and handling

	procedure for proper handling and storage of hazardous materials?	Methods should include storage location, safe handling/transporting, verification that the procedure has been followed and reference to documents such as SDSs.		An approved flammable storage cabinet is provided.	contained in Safety Data Sheets and labels) that detail the safe handling, use, storage, clean-up and transportation of hazardous materials are not in place.		of hazardous materials. This can be combined with clean-up of spills as well. Include storage of flammable liquids at the facility.
14.11	Is there a documented procedure for entering confined spaces?	Methods should include verification of air quality prior to entry into confined spaces, entry permits, air and personnel monitoring while in confined spaces, ventilation, entry procedures, attendant, communication, PPE, safe retrieval, emergency rescue procedures, equipment and records, etc.	Partial	Confined space hazard assessments have been recently completed and are documented in SWP-P039 Confined & Restricted Space Hazard Assessments.	A comprehensive confined space program is not documented to describe all elements of hazard assessment, pre-entry, atmospheric monitoring, entry, rescue, training, and equipment calibration and maintenance.	Documentation and Interview	Develop and implement a documented confined space entry program that includes all elements required by the legislation. Include a full description of the qualifications and dates of the persons who performed the hazard assessments.
14.12	Have personnel been trained on the above procedures?	Verify that raining includes safe, handling, clean-up, use of WHMIS information, specific job requirements (confined spaces.)	Partial	Training and information has been provided on occupational health hazards in some areas including noise, heat stress, noxious plants, etc. WHMIS training has been completed.		Documentation	Train affected staff on all newly-developed procedures as they are implemented.
14.13	Does the organization provide and maintain adequate toilet and wash-up facilities?	Verify that the organization has provided or arranged for the use of toilet and clean-up facilities before work starts and that facilities are services as required.	Y	The facility is properly equipped with toilet and wash up facilities. Where necessary, portable toilets and wash-up facilities are provided at construction projects.		Observation and Interview	
14.14	Does the organization provide and maintain an adequate supply of potable drinking water?	Verify that drinking water and cups are available and sanitation exists.	Y	Facility drinking water is provided. Bottled water and potable water are provided for crews who work away from the facility.			
14.15	Does the organization provide and maintain	Confirm that SDSs are available in the workplace and accessible to workers and emergency response personnel. Review a sample of SDSs to confirm they are	Y	SDSs are available and up to date.	There did not appear to a WHMIS procedure that defines and describes		Develop a WHMIS procedure that defines responsibilities and details for WHMIS compliance

	current Safety Data Sheets?	current.			responsibilities for ensuring that requirements are met in regards to labels, SDSs, and worker training.		respecting inventories, SDSs, and labeling requirements.
14.16	Does the organization provide and maintain properly labeled hazardous materials?	This should include all incoming, stored, in-process and finished materials. All packaging and storage areas should be properly labeled and any missing or damaged labels must be immediately replaced.	Y	Hazardous materials were properly labelled.		Observation or Interview	

ELEMENT 15-FIRST AID

Element #	Description	Guideline	Requirement Met? Y/N	Strengths	Needs	Verification Technique	Recommendations
15.1	Ensuring compliance with applicable regulations?	Verify the company is applying the relevant regulations (First Aid, WSIB, etc.)	Partial	The First Aid Regulation requirements are in most cases exceeded in terms of compliance.	There is no documented procedure that describes and defines responsibilities and measures to ensure compliance with the First Aid Regulation.	Documentation	Develop and implement a documented procedure to define and describe how the organization complies with First Aid regulations.
15.2	A qualified First Aider who is assigned to the kit/station and works in the immediate vicinity.	All first aid attendants must successfully complete training by a recognized training authority. Verify through interview that name of First Aider matches name on certificate.	Y	All staff are qualified as first aid attendants and work in the immediate vicinity of first aid stations.		Interview and Observation	
15.3	First aid certificate posted?	Copies of valid first aid certificates should be visible and made readily available at the first aid station for the designated first aid attendant(s.)	N		First aid certificates are not posted.	Observation	Post copies of first aid certificates near to the main first aid station, or on the health and safety postings board.
15.4	A process for	Verify a process exists to	Y	First aid attendants are		Documentation	

	maintaining and re-certifying first aid attendants.	ensure that qualified first aid attendants are available when and where required.		readily available when required.			
15.5	Periodic inspection of first aid facilities and equipment?	First aid facilities and equipment shall be inspected at least quarterly. Inspection records shall indicate the inspection date and the identity and signature of the inspector and be kept with the kit.	Y	An inspection process is in place. Kits are now equipped with a seal, that if unbroken, signifies the kit contents are complete.		Observation	
15.6	The responsibility of workers to report all injuries to supervisors?	Verify that workers understand that they must report all injuries to supervisors. This can be verified by reviewing procedure showing responsibility to report and by reviewing injury reporting form.	Y	Workers understand their obligations for reporting and recording of first aid injuries.		Documentation	
15.7	Records of all first aid treatment/advice?	Records of the circumstances of the injury, names of witnesses, nature and exact location of the injuries, date, time, and type of first aid treatment given.	Y	First aid treatments are recorded.		Documentation	
15.8	"In Case of Injury" poster is available at the first aid station.	Verify that Form 82-In Case of Injury poster is visible at the first aid station.	Y	Form 82 is posted.		Observation	

ELEMENT 16-HEALTH & SAFETY REPRESENTATIVE OR JOINT HEALTH & SAFETY COMMITTEE

Does the organization meet its legislated requirements for:

Element #	Description	Guideline	Requirement met Y/N?	Strengths	Needs	Verification Technique	Recommendations
16.1	Does the organization have documented procedures for the selection of roles and responsibilities and/or establishment criteria for JHSCs?	Verify that procedure/terms of reference exist.	Partial	A voluntary JHSC that meets the requirements of the OHSA has been established, although it is not legally required.	There is no documented procedure for the selection, roles, responsibilities, structure, function, and activities of the JHSC.	Documentation	Develop a documented terms of reference or procedure to define and describe the structure, function, and maintenance of the JHSC.
16.2	Selection or appointment of a health and safety representative where required?	Required for organizations that have between 5 and 19 employees. Selected by workers or appointed by trade union, if applicable.	Y	The health and safety representatives have been selected appropriately.		Documentation and interview	
16.3	Periodic health and safety inspections of the workplace.	Inspections of the workplace must be carried out at least monthly. Where it is not practicable to inspect the entire workplace monthly, the H & S Rep shall inspect a portion of the workplace each month such that the entire workplace will be inspected at least annually. Records of inspections shall be retained.	Y	Monthly inspections are completed by the JHSC.		Documentation	
16.4	Collection, review, corrective actions, implementation of actions and follow-up on H & S Rep. and JHSC recommendations?	Recommendations can result from workplace inspections, observations, discussions, reviews of training programs, worker requests or concerns, etc. Review records for recommendations, corrective actions and corrective action plans. Follow-up includes timely response to the originator on	Y	Recommendations are reviewed, corrective actions are implemented and follow-up activities are undertaken.		Documentation	

		all recommendations.					
16.5	Selection and composition of a workplace JHSC where required?	Verify list of JHSC members to ensure correct number and composition of worker and management reps. Verify existence of worker trades committee if applicable.	Y	The JHSC selection and composition requirements are met and exceeded.		Documentation and Interview	
16.6	Posting of JHSC member names and work locations?	The organization shall post the names and location of committee members in a visible location in the workplace.	Y	Names and work locations are posted.		Observation	
16.7	Frequency of meetings and the availability of minutes?	Verify records of meeting minutes and ensure meetings are being held at least every 3 months.	Y	Meeting are held, minutes are maintained and posted.		Documentation	

ELEMENT 17-WORKPLACE VIOLENCE & HARASSMENT

Does the organization have a workplace violence and harassment policy and program that:

Element #	Description	Guideline	Requirement Met? Y/N	Strengths	Needs	Verification Technique	Recommendations
17.1	Is signed by the president, CEO, or local senior management?	Ideally the Policy Statement should be signed by the president or CEO of the organization, or the senior-most leader of the division.	N	The policy is contained in EHS-P13-Workplace Violence and Harassment.	The policy is not signed by the President.	Documentation	Develop a single page workplace violence and harassment policy statement that is dated within one year, and is signed by the President.
17.2	Includes a program that outlines roles and responsibilities of all workplace parties?	The policy should outline the roles and responsibilities of all workplace parties regarding their participation in the workplace violence and harassment program. A workplace party is a person, visitor, contract or temporary worker or group inside the workplace concerned with or affected by the OH&S performance of an organization.	Y	The program describes roles and responsibilities of all workplace parties.	The procedure contains references to Bill 168 which were accurate in 2010. Bill 132 is also referenced, but no longer applies after revisions to Part III.0.1 of the OHSA were enacted. References do not include the Ministry of Labour Code of Practice for Harassment.	Documentation and Interview	Revise the existing program and procedures to reflect the OHSA requirements and remove references to Bill 168 and 132, and include references to Ministry of Labour guidelines and codes of practice.
17.3	Recognizes the right of workers to work in a violence and harassment free work environment?	The Policy Statement must clearly state that management (CEO, president, etc.) recognizes that all workers have the right to work in a violence and harassment free workplace.	Y	The rights of workers are reflected in the policy and procedure.		Documentation	
17.4	Is current?	The policy statement shall indicate its date of issuance.	N		EHS-P13 is dated June 2010, and shows revisions and related dates at the end of the document up to 2017.	Documentation	See comments in element 17.1 above.
17.5	Is reviewed annually?	The review shall be conducted by senior management at	Y	The policy and procedure were reviewed in 2017.		Documentation	Ensure that the policy heading bears the current date and is

		least annually and records of the review shall be retained.					based on the annual review process.
17.6	Is visibly posted in the workplace or made available to the workers.	Policy to be posted in the workplace. It may be provided to workers in the form of a handbook, safety manual, as part of a procedure manual, or in electronic form. A workplace can also include traveling, working at client premises or working at home.	Y	The policy and procedure are posted on the H & S board.		Observation	
17.7	Periodically assesses the risk of violence in the workplace?	Assessments and reassessments shall be documented and must identify the potential violence risks in the workplace. Procedure must contain a documented requirement to reassess at set intervals.	Partial	Assessments for customer service and Outside staff exposures have been completed.	The hazard assessment for customer service does not include the risk of robbery associated with handling money and making deposits. The hazard assessment for Operations Staff has been completed. Both hazard assessments make reference to "Future Considerations" which may/may not have been implemented. The hazard assessments also made reference to a "Respect in the Workplace" policy which did not appear in any of the policies provided for review. Hazard assessments have not been completed for management staff. Hazard assessments do not include the risks associated with work-related travel.	Documentation and Interview	Complete accurate and comprehensive workplace violence hazard assessments for all positions. Workplace violence hazard assessments may be included in the overall Job Hazard Assessments (see element 2) or may separate documents. Revise the procedure and program to include periodic re-assessment of the risk of workplace violence. This is also necessary where changes may have occurred in the workplace or in work activities. Hazard controls that are listed in the hazard assessments should be revised to accurately define and describe the current measures and procedures that are in place.
17.8	Identifies specific controls for all identified risks?	Program must contain controls that eliminate or mitigate risks identified in the assessment that are associated with violence and harassment.	Partial		Although a number of control measures and procedures are in place, they are not defined and described in the procedure. The program does not describe flagging of customer files where	Documentation	Revise the procedures and program to accurately define and describe specific preventive control measures and procedures that are in effect.

					there is an identified risk factor based on an incident. It does not detail the process to ensure two people are in the customer service area at all times when open to the public.		
17.9	Includes procedures for summoning immediate assistance?	The program must also include measures and procedures available for summoning immediate assistance when workplace violence occurs or is likely to occur.	Partial	Measures and procedures are in place to summon immediate assistance.	Although a number of measures are in place to summon immediate assistance, they are not defined and described in the procedure and program.	Documentation	Revise the procedure and program to include specific detailed description of how to summon immediate assistance if there is an incident.
17.10	Includes reporting and investigation procedures?	Procedures shall address legislated reporting of incidents of workplace harassment/violence and the subsequent investigation and any required actions, if applicable.	Y	The procedure includes reporting and investigation requirements.		Documentation and Interview	
17.11	Is the program periodically reviewed?	The program should be consistent with the policy, reviewed at least annually and records of the review shall be retained.	Partial	The revised procedure reflects changes to the OHSA enacted in 2016 in relation to harassment and reporting/investigation.	See comments above in relation to annual policy review.	Documentation	The 20-page policy/procedure should be reviewed annually, and the policy/procedure date in the document header should be current to within one year.

ELEMENT 18-RETURN TO WORK AND RE-EMPLOYMENT

Element #	Description	Guideline	Requirement Met? Y/N	Strengths	Needs	Verification Technique	Recommendations
18.1	Is signed by the CEO or senior local management?	The RTW policy must be clearly written and state the exact procedures (in chronological order) that are to be followed from the time of the reported injury, to the injured worker's return to full employment. (This procedure could be developed as a result of completing a RTW self assessment using the WSIB guide.)	Partial	HR-P01 Safe Return to Work is issued by senior management.	The procedure is dated 2010, and is not signed by the President. It bears the names of individuals who no longer work at the workplace. The procedure does not clearly reflect the exact procedures to be followed from the time of the reported injury to the injured worker's return to full employment, including current WSIB requirements relating to work reintegration and re-employment.	Documentation	Revise the existing policy to align with the WSIB's policy for Work Reintegration. Consider completing the self-assessment guide provided by the WSIB to determine additional needs and action items. Ensure that the issuer is the current president, and that the policy is signed.
18.2	Clearly defines the goal of the RTW program?	This could include ensuring that the employee will have the best opportunities available for successful return to work with their employer, or if required, to the labour market.	Partial	Most of the goals of the RTW program are defined.	The procedure does not include labour market employment if the injured worker cannot return to suitable and available work.	Documentation	See comments in element 18.1 above.
18.3	Provide a framework for the organization and the worker to cooperate in developing the RTW and re-employment plans for the worker?	The framework should include timing, responsibilities, constraints, and outcomes. Cooperation includes: initiating early contact; maintaining appropriate communication throughout the worker's recovery; identifying and securing Work Reintegration (WR) opportunities for the worker; providing WSIB with all relevant information concerning the WR and; notifying the WSIB of any dispute or disagreement concerning the WR.	Partial	The existing procedure describes some of the framework of the return to work and re-employment planning process.	The procedure does not comprehensively describe all timing, constraints, communications, WSIB information and work reintegration.	Documentation	See comments in element 18.1 above.
18.4	Does the procedure address the	Employers have a duty to modify the work or the	Y	The existing procedure reflects		Documentation	

	employer's duty to accommodate?	workplace to accommodate the needs of the worker to the extent of undue hardship as set out under the WSIA, Ont. Human Rights Code or Canadian Human Rights Act.		the employer's duty to accommodate.			
18.5	Does the procedure provide a re-entry plan for the worker's eventual transition to full-time employment?	Process will outline: assistance and services available to identify suitable work with employer or re-entry into the labour market; the duration of the plan; payment of expenses for the duration for the re-entry plan and; offer of re-location services.	Partial	The existing procedure covers some of the elements of the re-entry plan.	Labour market re-entry provisions and processes; payment of expenses for the duration of the re-entry plan; and offer of relocation services are not covered in the procedure.	Documentation	Include labour market re-entry, payment of expenses for the duration of the re-entry plan, and offer of re-location services in the procedure.
18.6	Addresses communication of RTW responsibilities to all involved parties?	Documented roles and responsibilities vary depending on the size of the organization, and can include the RTW program coordinator, human resources, project manager, safety coordinator, injured worker, medical department or health care provider, WSIB, and site supervisor.	Partial	The majority of roles and responsibilities are covered.	The responsibilities of the health care provider are not comprehensively covered.	Documentation	See comments in element 8.1 above.
18.7	Does the procedure address modification of duties based on job tasks and their specific physical demands?	Suggested modified duties during transition should reflect the physical demands of the worker's normal job/work and the work to be performed. The organization should have a list of types of work, tasks involved and the physical demands of the tasks. Some consideration: ergonomics, including lifting, walking, bending, sitting, twisting, vibration, work posture, temperature, humidity, etc.	Partial	Modification of duties based on functional abilities is defined in the procedure.	Completion of a physical demands analysis is not included in the procedure. Modification of duties would be done on a case-by-case basis and there is not a list of the types of work and tasks that may be used for modified duties.	Documentation	Revise the procedure to include completion of a physical demands analysis to assist in developing modified duties on a case-by-case basis.
18.8	Does the procedure address WSIB correspondence?	E.g. worker wage changes; all expenses related to RTW and WR changes in worker duties; adjustment to duration of RTW program; failure to cooperate, miscellaneous correspondence and return to full employment/close out, etc.	Partial	Correspondence with WSIB is somewhat defined.	Failure to cooperate is not described in the procedure, nor is the requirement for the employer to maintain regular contact with WSIB.	Documentation	Revise the procedure to ensure that required correspondence with WSIB is initiated and done by the person responsible for managing the claim. This will ensure that all required information is submitted to the WSIB in a timely and appropriate manner. The procedure can also include a process for response to WSIB requests for additional

							correspondence.
18.9	Does the company annually review its RTW and re-employment program, identify gaps and develop an action plan to improve the program?	This gap analysis can be done using the WSIB RTW self-assessment guide and referencing the Re-Employment legislation. A written gap analysis and action plan must be verified to get credit for this question. (A comparison with the previous year's gap analysis should also be done.)	N		Although the existing procedure is maintained, there did not appear to be a formalized process for regular review. This is likely due to the fact that there has not been a WSIB claim for several years so it hasn't been necessary to implement the claims management and WSIB procedures.	Documentation	Ensure that the RTW program is reviewed annually. The WSIB's RTW self-assessment guide may be used to assist in this process.

ELEMENT 19-MANAGEMENT REVIEW

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
19.1	Does senior management have a policy for conducting an annual review of the organization's OH&S program?	The intent of the review is for senior management to ensure continual improvement by evaluating the suitability, adequacy, and effectiveness of the OH&S program.	Partial	EHS-P01-Leadership and Administration policy specifies annual review of the health and safety program.	The majority of EHS policies have issue dates of 2009 and 2010 (contained in the policy header,) and the individuals who prepared and issued the policies no longer work for Niagara-on-the-Lake Hydro. The revision section at the end of the policies does contain detail relating to periodic review and revision of the original policies.	Documentation	Section 4.2 of the policy states: "evaluation by independent third party will be completed annually through the Zero Quest Audit process." This statement should be revised to reflect how the organization will plan to evaluate the H & S program because Zero Quest program is now obsolete. Revise the EHS and SWP headers to reflect the current issue date (within one year) in order to indicate that the policies are up to date, and current.
19.2	Does senior management have a procedure for conducting an annual review of the organization's OH&S program?	The procedure must include all steps in conducting the review including: responsibilities, frequency of review (minimum annually), objectives and action plans, record retention.	Y	EHS-P01-Leadership and Administration policy includes details pertaining to responsibilities, frequencies, objectives, and action plans. Records are maintained of the review.		Documentation	
19.3	Does the review	Verify that records of the review	Y	The organization participated		Documentation	

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
	include evaluation of all elements of the OH&S program?	include all elements of the organization's OH&S program including: • Internal records such as inspections, hazard assessments, incident reports, statistical reports • External communications such as evaluations conducted by other parties, evaluations of legal compliance, etc. • Follow up actions from previous management reviews Changing circumstances including developments in legal and other requirements related to OH&S (changes in business conditions, organizational structures, materials and services, legal and other requirements.)		in the Zero Quest program and attained platinum level in 2015. This program, in addition to on-going internal review, were used to generate review of policies, procedures, inspections, site visits, incident reports and follow up actions. The organization retains a health and safety consultant to provide expertise and resources to regularly review the elements of the H & S program in consultation with the JHSC. The organization is also a member of CHEC, and other professional/industry organizations. These networks further assist NOTL Hydro in evaluating its performance against industry partners and best practices. Changes in legal and regulatory requirements are routinely considered when developing program elements. 2018 objectives including having a third party audit of the program and related elements.			
19.4	Does the review include assessing the OH&S performance of the organization?	Verify that: Key performance indicators have been developed, measured and analyzed to determine the overall OH&S performance. Comparison from previous statistics is reviewed and any future steps necessary to prevent reoccurrence are implemented. The review of OH&S objectives has been performed to determine whether objectives/target have been met.	Y	Key performance indicators are developed, measured and analyzed through ongoing efforts. The JHSC is integral to this process as well. Opportunities for improvement are identified and adjustments to the program and management system are made.		Documentation	

Element #	Description	Guideline	Requirement met? Y/N	Strengths	Needs	Verification Technique	Recommendations
		Opportunities for improvement have been identified and changes made to the OH&S management system. Changes have been made to the OH&S policy and objectives (if applicable.)					
19.5	Has an action plan been developed based on the review?	Verify that an action plan that supports the assessment and findings has been developed	Y	Goals and action plans are implemented, and reflected in the minutes of the JHSC meetings, safety meetings, and in minutes of Board meetings. The findings and recommendations of this H & S Program Evaluation will assist the organization in further action planning efforts.		Documentation	Develop an action plan based on the findings and recommendations of this report and other sources.
19.6	Have the OH&S objectives been identified as a result of the review?	Verify that OH&S objectives reflect the outcomes of the current review.	Y	The current review activities have led to establishing goals and objectives for 2018. Objectives and goals are relevant to the organization's review activities.		Documentation	This report may be used to assist in setting additional goals and objectives for the H & S program.
19.7	Have the OH&S objectives and action plan(s) been communicated to all personnel?	Records are to be retained for at least 3 years.	Y	Objectives and action items are routinely communicated to all staff. Employee engagement forms a critically important part of the success of NOTL Hydro's H & S program.		Documentation and Interview	

NIAGARA-ON-THE-LAKE HYDRO

DISTRIBUTION SYSTEM PLAN

APPENDIX

E

RECEIVED JUN 27 2012

Date: June 25, 2012

To: Niagara on the Lake Hydro
PO Box 460
8 Henegan Road
Virgil, Ontario
L0S 1T0

Attention: Hassan Syed

Re: NOTL DS T1 and T2 Condition

Dear Hassan,

Thank you for providing us with the opportunity to assess the condition of your transformers at NOTL DS.

Introduction:

We have performed a review of our archived oil samples and test reports for T1 and T2 at Niagara on the Lake DS. We have also reviewed previous insulation resistance and power factor tests.

A frequency response analysis (FRA) was performed on May 9, 2012. Frequency response analysis is a useful tool to evaluate shifts in transformer windings over time due to through faults and/or deterioration. Since no baseline FRA test data was available, the FRA test results of the two virtually identical units at NOTL DS have been compared to each other.

Although only incomplete loading data was available, available information was reviewed as part of this assessment. Available loading data included periodic meter readings by Ascent and averaged monthly demand. Averaged monthly demand data was provided by NOTL Hydro.

14719 Bayham Drive, RR #3, Tillsonburg, ON N4G 4G8 Tel: 519-842-6458 Fax: 519-842-3775 Toll Free: 1-800-565-6790

Summary of Findings:

Oils:

Both units appear to be fit for continued service, although it is evident from the test data that the replacement of both transformers should be considered and budgeted for within the next five years, as both transformers are approaching end of life age, regardless of their current condition. Seasonal overloading is a concern – dissolved gas analysis (DGA) indicates that degradation of the cellulose insulation of both transformer cores has occurred in the past and will continue to occur under current operating conditions, although the rate of degradation has remained static.

The oil analysis of NOTL DS-T1 shows elevated levels of ethylene, which can be formed when metal parts of the transformer overheat under oil. Interfacial tension of the insulating oil of NOTL DS-T1 is barely within acceptable limits. For a detailed analysis of oil conditions for both transformers, please refer to Oil Analysis Report 24643LSP dated June 25, 2012. Furan analysis indicates that the mechanical strength of the solid insulation of the core of NOTL DS-T1 is close to that which would be found in a new transformer.

The oil analysis of NOTL DS-T2 shows levels of hydrogen just below IEEE condition 1 limits. This is potentially an indication of corona discharge occurring under oil. Furan analysis indicates that the mechanical strength of the solid insulation of the core of NOTL DS-T2 is close to that which would be found in a new transformer.

FRA Analysis:

The provided plots should be placed side by side to compare the frequency responses of NOTL DS-T1 to NOTL DS-T2

It is not possible to reach a definitive conclusion regarding the condition of either transformer from the FRA plots alone. The magnitude and phase response for the same test configurations for the two transformers are remarkably similar. Variations were observed in magnitude and phase response for the primary side (115kV) windings in the 1 kHz-10 kHz range for NOTL DS-T1. Test instrument probes were attached between phases B and A with the ground attached to phase A. This could be indicative of a primary winding shift due to a through fault, or shifting of the windings due to age and insulation degradation.

NOTL DS-T2 shows a variation of magnitude and phase response when the test instrument probes are attached between phases B (115kV) and b1 (27.6kV) with the ground attached to the neutral point of the secondary winding (27.6kV) of the transformer. It is difficult to guess what the cause of this variation might be, especially given the relatively better health of NOTL DS-T2 when compared to NOTL DS-T1. Winding shift or an anomaly in the solid insulation or core ground may be the cause. This result should not be cause for concern without baseline FRA data for this transformer.

Load:

Load information provided to Ascent by NOTL Hydro reveals that the transformers may loaded beyond their respective 30MVA capacities during the summer months. Overloading may be partly to blame for elevated carbon dioxide levels in the insulating oil.

Other Tests:

Insulation resistance tests showed that the insulation resistance of both units is within NETA limits. Insulation power factor is below 0.5%, which is within the recommended limits for new equipment. Winding ratio tests showed no indication of shorted windings. Winding resistance is within acceptable limits.

Further Recommendations:

Both NOTL DS-T1 and NOTL DS-T2 are fit for continued service – although there are indications of overloading. Since the transformers will continue to be overloaded, and are approaching the end of their design life, the following measures should be taken to ensure continued trouble free service.

Perform a Detailed Load Study for NOTL DS:

A detailed load study will show the duration and magnitude of transformer overloading, and will help determine whether or not elevated dissolved gas levels are due to overloading or hot spot activity. A detailed load study will also be helpful from a system planning perspective. Such a study would consist of collected and graphed amperage and/or kVA readings at intervals of several minutes over a period of several days each month. This information may be available from existing monitoring systems.

Oil Sampling Frequency:

Quarterly oil sampling is recommended for both transformers, to ensure that rapid deterioration of insulation is not occurring. This is recommended in the most recent Weidmann oil sample test report for NOTL DS-T2 (please refer to Oil Analysis Report 24743LSP dated June 25, 2012).

We hope that our comments will be helpful to NOTL Hydro. We look forward to being of continued service. Please contact me if you have any questions regarding this letter.

Yours sincerely,

Ben White
Ascent Solutions Inc.

Email: bwhite@ascent.ca
Phone: (519) 842-6458 x256
Cell: (519) 521-1170

June 7, 2012

Niagara on the Lake Hydro
8 Henegan Road
Virgil, ON
L0S 1T0

Attention: Hassan Syed

Re: Maintenance Inspection Report - Our Ref: 24743LSP
Site: NOTL DS – 801 Concession 5, Virgil

Dear Hassan,

Please find the attached report for the maintenance work and inspections completed May 8, 2012 at the NOTL DS substation.

Ascent Solutions inspected and tested T1 and T2 as required. A summary of the site findings is listed below for your review. All findings are referenced to the Ontario Electrical Safety Code (OESC).

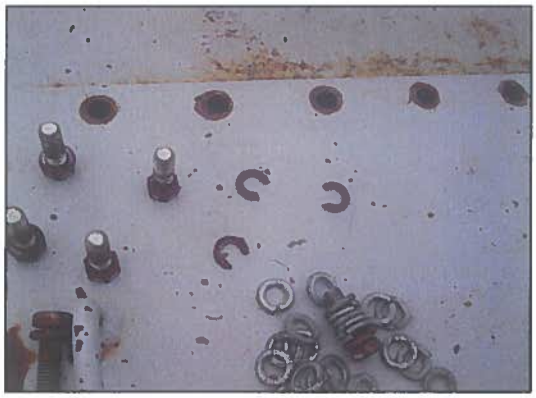
T1

Findings/Repairs:

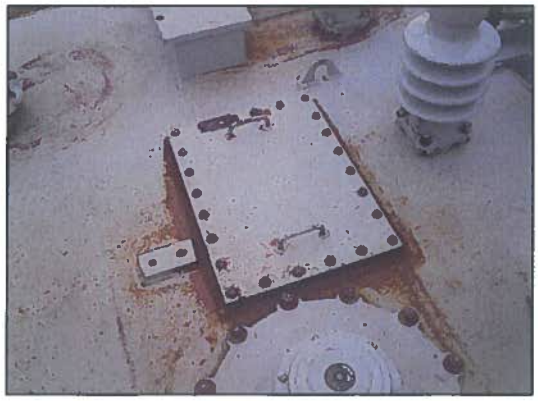
- All test results found satisfactory

- Oil found to be very clear in tank, non-visible in transformer on internal inspection

- Replaced lock washers as three were found broken



- Transformer showing signs of rust



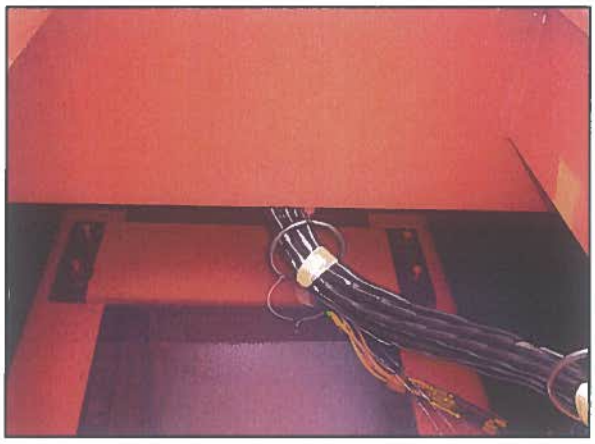
Recommendations:

- Continue with regular maintenance inspections to keep equipment clean and in good working condition
- Repaint transformer to prevent further rusting

T2

Findings/Repairs:

- All test results found satisfactory
- Oil found very clear in tank with none visible on the transformer



- Transformer showing signs of rust

Recommendations:

- Continue with regular maintenance inspections to keep equipment clean and in good working condition
- Repaint transformer to prevent further rusting

All other equipment that we tested appears in satisfactory condition, suitable for continued service.

Please give us a call should you wish us to provide you pricing and services for any or all of the recommended repairs listed in this report.

If you have any questions/concerns please do not hesitate to contact us. We look forward to being of continued service to Niagara on the Lake Hydro.

Sincerely,
ASCENT

Doug Charron
E.E. Technician, Master Electrician
Maintenance & Technical Services
Phone: (519) 842-6458
Fax: (519) 842-2496
Cell: (519) 521-2600

May 8, 2012

Niagara on the Lake Hydro
8 Henegan Road
P.O. Box 460
Virgil, ON
L0S 1T0

Attention: Mr. Craig McLean

Re: Oil Analysis Report – Our Ref: 24570LSP
Transformer: Westinghouse, Serial No. A3S5671

Dear Craig,

Attached are the results of the oil analysis of samples recently taken from the 3 Transformers and 3 LTC's located at your substations by Niagra-on-the-Lake.

➢ **Transformer – T1, Westinghouse, Serial No. A3S5671**

- ***Dissolved Gas Analysis (DGA) (Resample)***

  The gas in oil analysis indicates that the oil appears to be reasonably satisfactory. With the exception of Ethylene (C2H4) and Carbon Dioxide (CO2), all of the other gases remained within the IEEE recommended limits. **Ethylene increased to *57 ppm* compared with results almost a year ago (*50 ppm*) (exceeding the IEEE limit of *50 ppm*), while Carbon Dioxide jumped to *5749 ppm* compared with *4864 ppm* (exceeding IEEE limit of *4000 ppm*).** Trending shows there may be **a small hot spot slowly developing inside the transformer, possibly due to a bad connection inside.** Ethylene is usually accompanied by Ethane, together they sometimes called the "hot metal gases", however since levels of Ethane are not currently elevated, **no action is recommended at this time, but levels of Ethylene should be closely monitored.**

  Carbon Dioxide is a byproduct associated with the decomposition of the cellulose insulation, heat being a major factor of its rate produced, usually attributed to overloading. A transformer will also produce this gas along with Carbon Monoxide as it ages, and depending on the manufacturer type/model, varies in amounts produced, with Westinghouse models prone to having higher levels. **Concentrations in the key gases however have not made significant increases to warrant cause for any concern at this time, so no action is required. We do however recommend continued annual sampling to more accurately assess trends such as these.**

- ***Chemical Analysis (ASTM/Water)***

  The chemistry (ASTM) tests show that the oil is in satisfactory condition, remaining clear with trace amounts of sediments, and a slight amount of water content (*6 ppm*). All measured parameters remained within the IEEE recommended limits for acceptable in-service operation, however the **Interfacial Tension at *32.62 dynes/cm* was only slightly above the IEEE acceptable minimum limit of *30 dynes/cm*.**

- **Transformer – T2, Westinghouse, Serial No. A3S5672**

  - ***Dissolved Gas Analysis (DGA) (Resample)***

    The gas in oil analysis indicates that the oil appears to be satisfactory, and with the exception of Carbon Monoxide (CO) and Carbon Dioxide (CO2), all other gases remained within the IEEE recommended limits. **Carbon Monoxide increased to *881 ppm* from *773 ppm* almost a year ago (exceeding the IEEE limit of *570 ppm*), while Carbon Dioxide jumped to *5615 ppm* compared with *4509 ppm* (exceeding IEEE limit of *4000 ppm*).** Carbon Monoxide and Carbon Dioxide are produced through the decomposition to the paper insulation through overheating. A transformer will normally produce these gases over its lifespan with Westinghouse models typically producing excess levels of these gases. Through trending analysis we can also see that levels have been building up over time, thus no action is required at this time.

  - ***Chemical Analysis (ASTM/Water)***

    The chemistry (ASTM) tests show that the oil is in satisfactory condition, it remains clear and with no sediments and no appreciable amount of water content. All measured parameters remained within the IEEE recommended limits for acceptable in-service operation.

- **Transformer – York DS, Ferranti Packard, Serial No. 5016910101**

  - ***Dissolved Gas Analysis (DGA) (Resample)***

    The gas in oil analysis indicates that the oil appears to be satisfactory, with levels for all of the key gases within the currently recommended IEEE limits, thus no action is required at this time.

  - ***Chemical Analysis (ASTM/Water)***

    The chemistry (ASTM) tests show that the oil is in satisfactory condition, remaining clear and with no sediments and having a slight amount of water content (*7 ppm*). All measured parameters remained within the IEEE recommended limits for acceptable in-service operation.

- **Load Tap Changer – LTC T1, ABB, Serial No. 8380980**

  - ***Dissolved Gas Analysis (DGA) (Resample)***

    The gas in oil analysis indicates that the oil appears to be satisfactory, with levels for all of the key gases within the currently recommended IEEE limits, thus no action is required at this time.

  - ***Chemical Analysis (ASTM/Water)***

    The chemistry (ASTM) tests show that the oil is in satisfactory condition, remaining clear and with no sediments, having a moderate amount of water content (*19 ppm*). All measured parameters remained within the IEEE recommended limits for acceptable in-service operation.

- **Load Tap Changer – LTC T2, ASEA, Serial No. 2285139**

  - ***Dissolved Gas Analysis (DGA) (Resample)***

    The gas in oil analysis indicates that the oil appears to be satisfactory, with levels for all of the key gases within the currently recommended IEEE limits, thus no action is required at this time.

  - ***Chemical Analysis (ASTM/Water)***

    The chemistry (ASTM) tests show that the oil is in satisfactory condition, remaining clear and with no sediments, having a moderate amount of water content (*15 ppm*). All measured parameters remained within the IEEE recommended limits for acceptable in-service operation.

- **Load Tap Changer – York TS LTC, Reinhausen, Serial No.C014959**

  - ***Dissolved Gas Analysis (DGA) (Resample)***

    The gas in oil analysis indicates that the oil appears to be satisfactory, with levels for all of the key gases within the currently recommended IEEE limits, thus no action is required at this time.

  - ***Chemical Analysis (ASTM/Water)***

    The chemistry (ASTM) tests show that the oil is in satisfactory condition, remaining clear and with no sediments, having a moderate amount of water content (*17 ppm*). All measured parameters remained within the IEEE recommended limits for acceptable in-service operation.

Please call us if you have any questions regarding this analysis. We look forward to being of continued service to Niagara on the Lake Hydro in the future.

Sincerely,
ASCENT

Doug Charron
Electrical Technician/Master Electrician
Maintenance & Technical Services
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TEST REPORT
01-6406014-388493-00

:CENT SOLUTIONS INC.	**Serial#:** A3S5671	**Mfr:** WESTINGHOUSE	**Control#:** 6406014
14719 BAYHAM DR, RR#3	**Location:** NOTL DS-T1	**kV:** 115.5	**Order#:** 388493
	Equipment: TRANSFORMER	**kVA:** 25000	**Account:** 6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:** MAIN(BOTTOM)	**Year Mf'd:** 1983	**Received:** 04/11/2012
ATTN: WARNER ARDELT	**Breathing:** SEAL	**Syringe ID:** 8000107	**Reported:** 04/23/2012
PO#: AS1-128502	**Bank:** NA **Phase:** 3	**Bottle ID:**	
Project ID: 24570LSP	**Fluid:** MINUS **Gal:** 20473	**Sampled By:** DB	
Customer ID: T1			

	Lab Control Number:	6406014	6381969	6271839	6138757	6003571
	Date Sampled:	04/02/2012	01/18/2012	03/24/2011	04/06/2010	02/10/2009
	Order Number:	388493	383108	359663	332091	300050
	Oil Temp:	20		15	40	20
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (ppm):**	12		12	7	2.7
ASTM	**Methane (CH4) (ppm):**	5		4	4	4.0
D-3612	**Ethane (C2H6) (ppm):**	7		6	6	5.0
	Ethylene (C2H4) (ppm):	**57**		**50**	**64**	**58**
	Acetylene (C2H2) (ppm):	<1		<1	<1	<1
	Carbon Monoxide (CO) (ppm):	202		170	129	135
	Carbon Dioxide (CO2) (ppm):	**5749**		**4864**	**4910**	**5070**
	Nitrogen (N2) (ppm):	66401		64472	67003	71788
	Oxygen (O2) (ppm):	28579		26057	34132	23586
	Total Dissolved Gas (TDG) (ppm):	101012		95635	106255	10.3
	Total Dissolved Combustible Gas (TDCG) (ppm):	283		242	210	205
	Equivalent TCG (%):	0.2087		0.1874	0.1286	

DGA Diagnostics (most recent sample)	**DGA Keys Gas / Interpretive Method: PER IEEE C57.104-2008**	Hydrogen within condition 1 limits (100 ppm). Methane within condition 1 limits (120 ppm). Ethane within condition 1 limits (65 ppm). Ethylene: Condition 2 Indications of overheated (>350°C) oil (50 ppm). Acetylene within condition 1 limits (1 ppm). Carbon Monoxide within condition 1 limits (350 ppm). Carbon Dioxide: Condition 3 Significant Indications of overheated cellulose insulation (4000 ppm). TDCG within condition 1 limits (720 ppm).
	DGA TDCG Rate Interpretive Method: PER IEEE C57.104-2008 (two most recent sample)	Retest Annually. 1-Continue normal operation.
	DGA Cellulose (Paper) Insulation:	CO2/CO Ratio not applicable - neither gas exceeds its limit.
	WDS DGA Condition Code:	CAUTION
	WDS Recommended Action:	Resample within 6 months for testing.

Comment:

General Oil Quality (GOQ)						
D-1533	**Moisture in Oil**	**(ppm):**	6	4	4	3.5
D-971	**Interfacial Tension**	**(dynes/cm):**	32.62	34.8	34.0	36.1
D-974	**Acid Number**	**(mg KOH/g):**	0.043	0.032	0.031	0.02
D-1500	**Color Number**	**(Relative):**	L2.0	L2.0	L2.0	2.0
D-1524	**Visual Exam.**	**(Relative):**	CLR&SPRK	CLR&SPRK	CLR&SPRK	Clear
D-1524	**Sediment Exam.**	**(Relative):**	TRACE	ND	ND	
D-877	**Dielectric Breakdown**	**(kV):**	41	43	44	58
D-1298	**Specific Gravity**	**(Relative):**	0.8649	0.868	0.867	0.863

GOQ Diagnostics PER IEEE C57.106-2006 (most recent sample)	**Moisture in Oil:**	Acceptable for in-service oil (25 ppm max).
	Interfacial Tension:	Acceptable for in-service oil (30 dynes/cm min).
	Acid Number:	Acceptable for in-service oil (0.15 mg KOH/g max).

.tations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6406014-388493-00

.CENT SOLUTIONS INC.	**Serial#:**	A3S5671	**Mfr:**	WESTINGHOUSE	**Control#:**	6406014
14719 BAYHAM DR, RR#3	**Location:**	NOTL DS-T1	**kV:**	115.5	**Order#:**	388493
	Equipment:	TRANSFORMER	**kVA:**	25000	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1983	**Received:**	04/11/2012
ATTN: WARNER ARDELT	**Breathing:**	SEAL	**Syringe ID:**	8000107	**Reported:**	04/23/2012
PO#: AS1-128502	**Bank:** NA	**Phase:** 3	**Bottle ID:**			
Project ID: 24570LSP	**Fluid:** MIN	**USGal:** 20473	**Sampled By:**	DB		
Customer ID: T1						

	Lab Control Number:	6406014	6381969	6271839	6138757	6003571
	Date Sampled:	04/02/2012	01/18/2012	03/24/2011	04/06/2010	02/10/2009
	Order Number:	388493	383108	359663	332091	300050
	Oil Temp:	20		15	40	20
	Color Number and Visual:	Diagnostic not applicable. Diagnostic not applicable.				
	Dielectric Breakdown D-877:	Diagnostic not applicable.				
Comment:						
PCB	**Concentration (ppm):**		< 1.0 PPM			
ASTM Method D-4059	**PCB Type (Arocolor):**		ND			
	Reporting Limit:		1.0			
Comment:						

End of Test Report

Authorized By: _____

.ations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6406012-388493-00

SCENT SOLUTIONS INC.	**Serial#:**	A3S5672	**Mfr:**	WESTINGHOUSE	**Control#:**	6406012
14719 BAYHAM DR, RR#3	**Location:**	NOTL DS-T2	**kV:**	115.5	**Order#:**	388493
	Equipment:	TRANSFORMER	**kVA:**	25000	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1983	**Received:**	04/11/2012
ATTN: WARNER ARDELT	**Breathing:**	SEAL	**Syringe ID:**	8003857	**Reported:**	04/23/2012
PO#: AS1-128502	**Bank:** NA	**Phase:** 3	**Bottle ID:**			
Project ID: 24570LSP	**Fluid:** MIN	**USGal:** 20473	**Sampled By:**	DB		
Customer ID: T2						

	Lab Control Number:	6406012	6381970	6271835	6138752	6003570
	Date Sampled:	04/02/2012	01/11/2012	03/24/2011	04/06/2010	02/10/2009
	Order Number:	388493	383108	359663	332091	300050
	Oil Temp:	20		15	20	20
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (ppm):**	83		96	118	93
ASTM	**Methane (CH4) (ppm):**	18		17	18	18
D-3612	**Ethane (C2H6) (ppm):**	15		13	15	14
	Ethylene (C2H4) (ppm):	26		20	31	28
	Acetylene (C2H2) (ppm):	<1		<1	<1	<1
	Carbon Monoxide (CO) (ppm):	**881**		**733**	**858**	**813**
	Carbon Dioxide (CO2) (ppm):	**5615**		**4509**	**4984**	**4994**
	Nitrogen (N2) (ppm):	76615		71174	83529	71482
	Oxygen (O2) (ppm):	3226		2549	5534	<500
	Total Dissolved Gas (TDG) (ppm):	86479		79111	95087	7.9
	Total Dissolved Combustible Gas (TDCG) (ppm):	**1023**		**879**	**1040**	**967**
	Equivalent TCG (%):	0.993		0.9574	0.9512	

DGA	**DGA Keys Gas / Interpretive Method:**	Hydrogen within condition 1 limits (100 ppm).
Diagnostics	**PER IEEE C57.104-2008**	Methane within condition 1 limits (120 ppm).
	(most recent sample)	Ethane within condition 1 limits (65 ppm).
		Ethylene within condition 1 limits (50 ppm).
		Acetylene within condition 1 limits (1 ppm).
		Carbon Monoxide: Condition 3 Indications of significantly overheated cellulose insulation (570 ppm).
		Carbon Dioxide: Condition 3 Significant Indications of overheated cellulose insulation (4000 ppm).
		TDCG: Condition 2 Levels exceed normal concentrations. Fault may be present (720 ppm).
	DGA TDCG Rate Interpretive Method:	Retest Quarterly.
	PER IEEE C57.104-2008	Exercise caution. Analyze for individual gases. Determine load dependence.
	(two most recent sample)	
	DGA Cellulose (Paper) Insulation:	Normal decomposition of cellulose insulation.
	WDS DGA Condition Code:	NORMAL
	WDS Recommended Action:	Continue normal operation. Resample for testing within one year.
Comment:		

General Oil Quality (GOQ)						
D-1533	**Moisture in Oil**	**(ppm):**	5	4	4	2.7
D-971	**Interfacial Tension**	**(dynes/cm):**	38.98	41.3	39.7	42.8
D-974	**Acid Number**	**(mg KOH/g):**	0.026	0.015	0.012	
D-1500	**Color Number**	**(Relative):**	1.0	L1.5	L1.5	1.5
D-1524	**Visual Exam.**	**(Relative):**	CLR&SPRK	CLR&SPRK	CLR&SPRK	Clear
D-1524	**Sediment Exam.**	**(Relative):**	ND	ND	ND	
D-877	**Dielectric Breakdown**	**(kV):**	45	42	50	58
D-1298	**Specific Gravity**	**(Relative):**	0.8636	0.867	0.867	0.861

GOQ Diagnostics	**Moisture in Oil:**	Acceptable for in-service oil (25 ppm max).
PER IEEE C57.106-2006	**Interfacial Tension:**	Acceptable for in-service oil (30 dynes/cm min).

ations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6406012-388493-00

SCENT SOLUTIONS INC.	**Serial#:**	A3S5672	**Mfr:**	WESTINGHOUSE	**Control#:**	6406012
14719 BAYHAM DR, RR#3	**Location:**	NOTL DS-T2	**kV:**	115.5	**Order#:**	388493
	Equipment:	TRANSFORMER	**kVA:**	25000	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1983	**Received:**	04/11/2012
ATTN: WARNER ARDELT	**Breathing:**	SEAL	**Syringe ID:**	8003857	**Reported:**	04/23/2012
PO#: AS1-128502	**Bank:** NA	**Phase:** 3	**Bottle ID:**			
Project ID: 24570LSP	**Fluid:** MIN	**USGal:** 20473	**Sampled By:**	DB		
Customer ID: T2						

	Lab Control Number:	6406012	6381970	6271835	6138752	6003570
	Date Sampled:	04/02/2012	01/11/2012	03/24/2011	04/06/2010	02/10/2009
	Order Number:	388493	383108	359663	332091	300050
	Oil Temp:	20		15	20	20
(most recent sample)	**Acid Number:**	Acceptable for in-service oil (0.15 mg KOH/g max).				
	Color Number and Visual:	Diagnostic not applicable. Diagnostic not applicable.				
	Dielectric Breakdown D-877:	Diagnostic not applicable.				
Comment:						
PCB	**Concentration (ppm):**	< 1.0 PPM				
ASTM Method D-4059	**PCB Type (Arocolor):**	ND				
	Reporting Limit:	1.0				
Comment:						

End of Test Report

Authorized By: _____

tions: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6406015-388493-00

SCENT SOLUTIONS INC.	**Serial#:**	5016910101	**Mfr:**	FERRANTI PACKARD	**Control#:**	6406015
14719 BAYHAM DR, RR#3	**Location:**	NOTL YORK DS	**kV:**	115.5	**Order#:**	388493
	Equipment:	TRANSFORMER	**kVA:**	41700	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	2003	**Received:**	04/11/2012
ATTN: WARNER ARDELT	**Breathing:**	FB	**Syringe ID:**	8000160	**Reported:**	04/23/2012
PO#: AS1-128502	**Bank:** NA	**Phase:** 3	**Bottle ID:**			
Project ID: 24570LSP	**Fluid:** MIN	**USGal:** 28172	**Sampled By:**	DB		
Customer ID:						

	Lab Control Number:	6406015	6271842	6138760	5659838	6003572
	Date Sampled:	04/02/2012	03/24/2011	04/06/2010	04/07/2009	02/10/2009
	Order Number:	388493	359663	332091	225747	300050
	Oil Temp:	20	12	40		16
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (ppm):**	5	12	6	<2	6.1
ASTM	**Methane (CH4) (ppm):**	2	2	2	2	2.2
D-3612	**Ethane (C2H6) (ppm):**	<1	<1	<1	<1	1.1
	Ethylene (C2H4) (ppm):	<1	<1	<1	1	1
	Acetylene (C2H2) (ppm):	<1	<1	<1	<1	<1
	Carbon Monoxide (CO) (ppm):	81	96	104	2	126
	Carbon Dioxide (CO2) (ppm):	739	677	608	589	811
	Nitrogen (N2) (ppm):	61899	56758	62290	60817	61860
	Oxygen (O2) (ppm):	30766	25334	34509	34320	28492
	Total Dissolved Gas (TDG) (ppm):	93492	82879	97519	95731	9.2
	Total Dissolved Combustible Gas (TDCG) (ppm):	88	110	112	5	134
	Equivalent TCG (%):	0.0865	0.129	0.1066	0.0025	

DGA Diagnostics	**DGA Keys Gas / Interpretive Method:**	Hydrogen within condition 1 limits (100 ppm).
	PER IEEE C57.104-2008	Methane within condition 1 limits (120 ppm).
	(most recent sample)	Ethane within condition 1 limits (65 ppm).
		Ethylene within condition 1 limits (50 ppm).
		Acetylene within condition 1 limits (1 ppm).
		Carbon Monoxide within condition 1 limits (350 ppm).
		Carbon Dioxide within condition 1 limits (2500 ppm).
		TDCG within condition 1 limits (720 ppm).
	DGA TDCG Rate Interpretive Method:	Retest Annually.
	PER IEEE C57.104-2008	1-Continue normal operation.
	(two most recent sample)	
	DGA Cellulose (Paper) Insulation:	CO2/CO Ratio not applicable - neither gas exceeds its limit.
	WDS DGA Condition Code:	NORMAL
	WDS Recommended Action:	Continue normal operation. Resample for testing within one year.

Comment:

General Oil Quality (GOQ)							
D-1533	**Moisture in Oil**	**(ppm):**	7	5	3	5	<2
D-971	**Interfacial Tension**	**(dynes/cm):**	39.59	41.5	39.9	29.7	43.5
D-974	**Acid Number**	**(mg KOH/g):**	0.018	0.009	0.005	0.005	
D-1500	**Color Number**	**(Relative):**	L1.	L1.0	1.0	L1.0	1.0
D-1524	**Visual Exam.**	**(Relative):**	CLR&SPRK	CLR&SPRK	CLR&SPRK	CLR&SPRK	Clear
D-1524	**Sediment Exam.**	**(Relative):**	ND	ND	ND	ND	
D-877	**Dielectric Breakdown**	**(kV):**	43	47	47	42	60
D-1298	**Specific Gravity**	**(Relative):**	0.8907	0.893	0.894	0.893	0.877

GOQ Diagnostics	**Moisture in Oil:**	Acceptable for in-service oil (25 ppm max).
PER IEEE C57.106-2006	**Interfacial Tension:**	Acceptable for in-service oil (30 dynes/cm min).
(most recent sample)	**Acid Number:**	Acceptable for in-service oil (0.15 mg KOH/g max).

tions: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6406015-388493-00

SCENT SOLUTIONS INC.	**Serial#:**	5016910101		**Mfr:**	FERRANTI PACKARD	**Control#:**	6406015
14719 BAYHAM DR, RR#3	**Location:**	NOTL YORK DS		**kV:**	115.5	**Order#:**	388493
	Equipment:	TRANSFORMER		**kVA:**	41700	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)		**Year Mf'd:**	2003	**Received:**	04/11/2012
ATTN: WARNER ARDELT	**Breathing:**	FB		**Syringe ID:**	8000160	**Reported:**	04/23/2012
PO#: AS1-128502	**Bank:** NA	**Phase:** 3		**Bottle ID:**			
Project ID: 24570LSP	**Fluid:** MIN	**USGal:** 28172		**Sampled By:**	DB		
Customer ID:							

Lab Control Number:	6406015	6271842	6138760	5659838	6003572
Date Sampled:	04/02/2012	03/24/2011	04/06/2010	04/07/2009	02/10/2009
Order Number:	388493	359663	332091	225747	300050
Oil Temp:	20	12	40		16
Color Number and Visual:	Diagnostic not applicable.				
Dielectric Breakdown D-877:	Diagnostic not applicable.				
Comment:					

End of Test Report

Authorized By: _____

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TEST REPORT
01-6406018-388493-00

3CENT SOLUTIONS INC.	**Serial#:** 8380980	**Mfr:** ABB	**Control#:** 6406018
14719 BAYHAM DR, RR#3	**Location:** NOTL-T1 LTC	**kV:** 115	**Order#:** 388493
	Equipment: LTC	**kVA:**	**Account:** 6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:** SELECTOR	**Year Mf'd:** 1998	**Received:** 04/11/2012
ATTN: WARNER ARDELT	**Breathing:** FB	**Syringe ID:** 8003818	**Reported:** 04/23/2012
PO#: AS1-128502	**Bank:** NA **Phase:** 3	**Bottle ID:**	
Project ID: 24570LSP	**Fluid:** MIN	**Sampled By:**	
Customer ID:	**Model:** UZERN		

	Lab Control Number:	6406018	6381969	6354003	6331511	6271854
	Date Sampled:	04/02/2012	01/18/2012	10/28/2011	08/17/2011	03/24/2011
	Order Number:	388493	383108	376959	371979	359663
	Oil Temp:	20				
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (ppm):**	22	<2	63	156	35
ASTM	**Methane (CH4) (ppm):**	7	1	23	31	18
D-3612	**Ethane (C2H6) (ppm):**	<1	<1	3	<1	4
	Ethylene (C2H4) (ppm):	9	**<1**	77	61	63
	Acetylene (C2H2) (ppm):	85	<1	694	672	616
	Carbon Monoxide (CO) (ppm):	5	2	20	28	11
	Carbon Dioxide (CO2) (ppm):	428	**220**	483	708	657
	Nitrogen (N2) (ppm):	60991	62328	62833	55106	59164
	Oxygen (O2) (ppm):	31327	28738	31679	25669	29115
	Total Dissolved Gas (TDG) (ppm):	92874	91289	95875	82431	89683
	Total Dissolved Combustible Gas (TDCG) (ppm):	128	3	880	948	747
	Equivalent TCG (%):	0.0649	0.0022	0.2348	0.5109	0.1666
DGA Diagnostics	**Ratio Analysis:**	Acetylene exceeds normal limits. Further analysis is recommended.				
omment:						
General Oil Quality (GOQ)						
D-1533	**Moisture in Oil (ppm):**	19	16	43	22	25
D-971	**Interfacial Tension (dynes/cm):**	47.52	47.8	45.44	46.9	46.7
D-974	**Acid Number (mg KOH/g):**		0.006	0.013		
D-1500	**Color Number (Relative):**	L0.5	L0.5	L0.5	L0.5	L0.5
D-1524	**Visual Exam. (Relative):**	CLR&SPRK	CLR&SPRK	CLR&SPRK	CLR&SPRK	CLR&SPRK
D-1524	**Sediment Exam. (Relative):**	ND	ND	ND	ND	ND
D-877	**Dielectric Breakdown (kV):**		48	34		
D1816	**Dielectric Breakdown 1 mm (kV mm-C):**	34 (1-23C)			18 (1-24C)	25 (1-23C)
D-1298	**Specific Gravity (Relative):**		0.8715	0.883		
GOQ Diagnostics	**Moisture in Oil:**	Acceptable for in-service oil (25 ppm max).				
PER IEEE C57.106-2006	**Interfacial Tension:**	Diagnostic not applicable.				
(most recent sample)	**Color Number and Visual:**	Diagnostic not applicable. Diagnostic not applicable.				
	Dielectric Breakdown D-1816:	Acceptable for in-service oil (28 kV min @ 1mm).				
Comment:						

End of Test Report

Authorized By: _____

ations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6406020-388493-00

;CENT SOLUTIONS INC.	**Serial#:** 2285139	**Mfr:** ASEA	**Control#:** 6406020
14719 BAYHAM DR, RR#3	**Location:** NOTL-T2 LTC	**kV:** 115	**Order#:** 388493
	Equipment: LTC	**kVA:**	**Account:** 6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:** COMMON	**Year Mf'd:**	**Received:** 04/11/2012
ATTN: WARNER ARDELT	**Breathing:** SEALED	**Syringe ID:** 8002246	**Reported:** 04/23/2012
PO#: AS1-128502	**Bank:** NA **Phase:** 3	**Bottle ID:**	
Project ID: 24570LSP	**Fluid:** MIN	**Sampled By:** DB	
Customer ID:	**Model:** UZERN		

	Lab Control Number:	6406020	6381969	6354004	6331512	6271856
	Date Sampled:	04/02/2012	01/18/2012	10/28/2011	08/17/2011	03/24/2011
	Order Number:	388493	383108	376959	371979	359663
	Oil Temp:	20				
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (ppm):**	37	<2	170	208	47
ASTM	**Methane (CH4) (ppm):**	6	1	39	44	31
D-3612	**Ethane (C2H6) (ppm):**	<1	<1	2	<1	4
	Ethylene (C2H4) (ppm):	6	<1	107	88	84
	Acetylene (C2H2) (ppm):	60	<1	1065	984	880
	Carbon Monoxide (CO) (ppm):	6	2	30	47	16
	Carbon Dioxide (CO2) (ppm):	422	220	622	941	784
	Nitrogen (N2) (ppm):	61465	62328	64109	56408	60289
	Oxygen (O2) (ppm):	30311	28738	32514	27164	29913
	Total Dissolved Gas (TDG) (ppm):	92313	91289	98658	85884	92048
	Total Dissolved Combustible Gas (TDCG) (ppm):	115	3	1413	1371	1062
	Equivalent TCG (%):	0.0962	0.0022	0.5061	0.6806	0.2275
DGA Diagnostics	**Ratio Analysis:**	Heating to arcing gas ratios within normal limits.				

;mment:

General Oil Quality (GOQ)						
D-1533	**Moisture in Oil**	**(ppm):**	15	16	30	18
D-971	**Interfacial Tension**	**(dynes/cm):**	46.98	47.8	45.98	47.1
D-974	**Acid Number**	**(mg KOH/g):**		0.006	0.013	
D-1500	**Color Number**	**(Relative):**	L0.5	L0.5	L0.5	L0.5
D-1524	**Visual Exam.**	**(Relative):**	CLR&SPRK	CLR&SPRK	CLR&SPRK	CLR&SPRK
D-1524	**Sediment Exam.**	**(Relative):**	ND	ND	TRACE	ND
D-877	**Dielectric Breakdown**	**(kV):**		48	33	
D1816	**Dielectric Breakdown 1 mm**	**(kV mm-C):**	34 (1-23C)			11 (1-24C)
D-1298	**Specific Gravity**	**(Relative):**		0.8715	0.883	
GOQ Diagnostics	**Moisture in Oil:**	Acceptable for in-service oil (25 ppm max).				
PER IEEE C57.106-2006	**Interfacial Tension:**	Diagnostic not applicable.				
(most recent sample)	**Color Number and Visual:**	Diagnostic not applicable. Diagnostic not applicable.				
	Dielectric Breakdown D-1816:	Acceptable for in-service oil (28 kV min @ 1mm).				

Comment:

End of Test Report

Authorized By: _____

ations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6406024-388493-00

CENT SOLUTIONS INC.	**Serial#:**	C014959	**Mfr:**	REINHAUSEN	**Control#:**	6406024
14719 BAYHAM DR, RR#3	**Location:**	NOTL (YORK TS)	**kV:**		**Order#:**	388493
	Equipment:	LTC	**kVA:**		**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	SELECTOR	**Year Mf'd:**	2003	**Received:**	04/11/2012
ATTN: WARNER ARDELT	**Breathing:**	VACUUM	**Syringe ID:**	8001091	**Reported:**	04/23/2012
PO#: AS1-128502	**Bank:** NA	**Phase:** 3	**Bottle ID:**			
Project ID: 24570LSP	**Fluid:** MIN	**USGal:** 268	**Sampled By:**	DB		
Customer ID:		**Model:** RMV-II				

		Lab Control Number:	6406024	6331513
		Date Sampled:	04/02/2012	08/16/2011
		Order Number:	388493	371979
		Oil Temp:	20	
Dissolved Gas Analysis (DGA)		**Hydrogen (H2) (ppm):**	4	10
ASTM		**Methane (CH4) (ppm):**	1	2
D-3612		**Ethane (C2H6) (ppm):**	<1	<1
		Ethylene (C2H4) (ppm):	<1	<1
		Acetylene (C2H2) (ppm):	<1	<1
		Carbon Monoxide (CO) (ppm):	3	10
		Carbon Dioxide (CO2) (ppm):	590	543
		Nitrogen (N2) (ppm):	59545	53721
		Oxygen (O2) (ppm):	30891	25052
		Total Dissolved Gas (TDG) (ppm):	91034	79338
		Total Dissolved Combustible Gas (TDCG) (ppm):	8	22
		Equivalent TCG (%):	0.0122	0.0372
DGA Diagnostics		**Ratio Analysis:**	Acetylene within normal limits.	
Comment:				
General Oil Quality (GOQ)				
D-1533	**Moisture in Oil**	**(ppm):**	17	21
D-971	**Interfacial Tension**	**(dynes/cm):**	30.42	30.72
D-974	**Acid Number**	**(mg KOH/g):**		0.016
D-1500	**Color Number**	**(Relative):**	1.0	L1.0
D-1524	**Visual Exam.**	**(Relative):**	CLR&SPRK	CLR&SPRK
D-1524	**Sediment Exam.**	**(Relative):**	ND	ND
D-877	**Dielectric Breakdown**	**(kV):**		31
D1816	**Dielectric Breakdown 1 mm**	**(kV mm-C):**	38 (1-23C)	
D-1298	**Specific Gravity**	**(Relative):**		0.893
GOQ Diagnostics		**Moisture in Oil:**	Acceptable for equipment > 69 kV for in-service oil - kV not provided (25 ppm max).	
PER IEEE C57.106-2006		**Interfacial Tension:**	Diagnostic not applicable.	
(most recent sample)		**Color Number and Visual:**	Diagnostic not applicable. Diagnostic not applicable.	
		Dielectric Breakdown D-1816:	Acceptable for equipment > 69 kV for in-service oil - kV not provided (28 kV min @ 1mm).	
Comment:				

End of Test Report

Authorized By: _____

Notations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

June 26, 2012

Niagara On The Lake Hydro
8 Henegan Road
P.O. Box 460
Virgil, ON
L0S 1T0

Attention: ***Hassan Syed***

Re: Oil Analysis Report - Our Ref: 24743LSP
Site: NOTL DS – 801 Concession 5 Road, Virgil, ON

Dear Hassan,

Attached are the oil analysis results of the samples recently taken from the transformers located at the NOTL DS in Virgil.

➢ **Transformer 1 – Westinghouse, Serial no. A3S5671**

- ***Dissolved Gas Analysis (DGA)***

  The history of the oil analysis indicates that there may be a "hot spot" developing inside the transformer, showing a level of Ethylene (C2H4) at ***72 ppm***. As well, Carbon Dioxide (CO2) was found at ***4083 ppm***. This level exceeds *Condition 2* of the IEEE recommended limit of ***2500 ppm***. Condition 2 indicates overheating and deterioration of the transformer windings paper insulation. With higher levels of Ethylene, close attention should be taken to monitor these gases through trending in subsequent samplings. It is recommended to continue sampling in short intervals, such as 6 month period or less, to monitor the transformer's health, particularly those gases which have exceeded IEEE recommended limits.

- ***Chemical Analysis (ASTM/Water)***

  The chemistry (ASTM) tests show that the oil itself is in satisfactory condition, remains clear and has no appreciable water content or sediments.

- ***Furanic Analysis***

  The results of the Furanic sampling indicate that the transformer has some appreciable 'wear' on its winding insulation. The value of *2-Furaldehyde* is *19 ppb* indicating some decomposition of the cellulose insulation has occurred via overheating. The *Degree of Polymerization (DP)* was evaluated to be *921* estimating the operating age at around 2 years. This is very good for a transformer which is 29 years old, the result however may be misleading, if the oil had previously been replaced.

- **Transformer 2 – Westinghouse, Serial no. A3S5672**

  - ***Dissolved Gas Analysis (DGA)***

    There is a finding of elevated Hydrogen dissolved in the oil now at ***97 ppm***. This is slightly lower than the IEEE recommended level of ***100 ppm***. Elevated hydrogen is an indication of partial discharge (corona) having occurred, as well there was a finding of elevated levels of Carbon Monoxide (CO) and Carbon Dioxide (CO2). The IEEE recommended levels for these are ***570 ppm*** and ***4000 ppm*** respectively. These gases are accompanied by medium concentrations of Methane (CH4), Ethane (C2H6), and Ethylene (C2H4).

  - ***Chemical Analysis (ASTM/Water)***

    The chemistry (ASTM) tests show that the oil itself is in satisfactory condition, remains clear and has no appreciable water content or sediments

  - ***Furanic Analysis***

    The results of the Furanic sampling indicate that the transformer has some appreciable 'wear' on its winding insulation. The value of *2-Furaldehyde* is *11 ppb* indicating that slight decomposition of the cellulose insulation has occurred thru overheating. The *Degree of Polymerization (DP)* was evaluated to be *995* estimating the operating age at almost 1 year. This is very good considering the vintage of this transformer (1983). This result however could be misleading, if the oil had previously been replaced.

Please call us if you have any questions regarding this analysis. We look forward to being of continued service to Niagara On The Lake Hydro in the future.

Sincerely,
ASCENT

Doug Charron
Electrical Technician/Master Electrician
Maintenance & Technical Services
Phone: (519) 842-6458
Fax: (519) 842-2496
Mobile: (519) 521-2600

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TEST REPORT
01-6418698-391375-00

ASCENT SOLUTIONS INC.	**Serial#:**	A3S5671	**Mfr:**	WESTINGHOUSE	**Control#:**	6418698
14719 BAYHAM DR, RR#3	**Location:**	NOTL DS-T1	**kV:**	115.5	**Order#:**	391375
	Equipment:	TRANSFORMER	**kVA:**	25000	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1983	**Received:**	05/15/2012
ATTN: WARNER ARDELT	**Breathing:**	SEAL	**Syringe ID:**	8000694	**Reported:**	05/24/2012
PO#: AS1-128692	**Bank:** NA	**Phase:** 3	**Bottle ID:**	A3S5671		
Project ID: 24743LSP	**Fluid:** MIN	**USGal:** 20473	**Sampled By:**	DB		
Customer ID: T1						

	Lab Control Number:	6418698	6406014	6381969	6271839	6138757
	Date Sampled:	05/09/2012	04/02/2012	01/18/2012	03/24/2011	04/06/2010
	Order Number:	391375	388493	383108	359663	332091
	Oil Temp:	35	20		15	40
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (ppm):**	8	12	<2	12	7
ASTM	**Methane (CH4) (ppm):**	4	5	1	4	4
D-3612	**Ethane (C2H6) (ppm):**	7	7	<1	6	6
	Ethylene (C2H4) (ppm):	**72**	**57**	**<1**	**50**	**64**
	Acetylene (C2H2) (ppm):	<1	<1	<1	<1	<1
	Carbon Monoxide (CO) (ppm):	191	202	2	170	129
	Carbon Dioxide (CO2) (ppm):	**4083**	**5749**	**220**	**4864**	**4910**
	Nitrogen (N2) (ppm):	62279	66401	62328	64472	67003
	Oxygen (O2) (ppm):	27024	28579	28738	26057	34132
	Total Dissolved Gas (TDG) (ppm):	93668	101012	91289	95635	106255
	Total Dissolved Combustible Gas (TDCG) (ppm):	282	283	3	242	210
	Equivalent TCG (%):	0.204	0.2087	0.0022	0.1874	0.1286

DGA Diagnostics	**DGA Keys Gas / Interpretive Method:** **PER IEEE C57.104-2008** (most recent sample)	Hydrogen within condition 1 limits (100 ppm). Methane within condition 1 limits (120 ppm). Ethane within condition 1 limits (65 ppm). Ethylene: Condition 2 Indications of overheated (>350°C) oil (50 ppm). Acetylene within condition 1 limits (1 ppm). Carbon Monoxide within condition 1 limits (350 ppm). Carbon Dioxide: Condition 3 Significant Indications of overheated cellulose insulation (4000 ppm). TDCG within condition 1 limits (720 ppm).
	DGA TDCG Rate Interpretive Method: **PER IEEE C57.104-2008** (two most recent sample)	Retest Annually. 1-Continue normal operation.
	DGA Cellulose (Paper) Insulation:	CO2/CO Ratio not applicable - neither gas exceeds its limit.
	WDS DGA Condition Code:	CAUTION
	WDS Recommended Action:	Resample within 6 months for testing.

Comment:

General Oil Quality (GOQ)							
D-1533	**Moisture in Oil**	**(ppm):**	4	6	16	4	4
D-971	**Interfacial Tension**	**(dynes/cm):**	33.78	32.62	47.8	34.8	34.0
D-974	**Acid Number**	**(mg KOH/g):**	0.045	0.043	0.006	0.032	0.031
D-1500	**Color Number**	**(Relative):**	L2.0	L2.0	L0.5	L2.0	L2.0
D-1524	**Visual Exam.**	**(Relative):**	CLR&SPRK	CLR&SPRK	CLR&SPRK	CLR&SPRK	CLR&SPRK
D-1524	**Sediment Exam.**	**(Relative):**	ND	TRACE	ND	ND	ND
D-877	**Dielectric Breakdown**	**(kV):**	50	41	48	43	44
D-1298	**Specific Gravity**	**(Relative):**	0.8642	0.8649	0.8715	0.868	0.867

GOQ Diagnostics	**Moisture in Oil:**	Acceptable for in-service oil (25 ppm max).
PER IEEE C57.106-2006	**Interfacial Tension:**	Acceptable for in-service oil (30 dynes/cm min).
(most recent sample)	**Acid Number:**	Acceptable for in-service oil (0.15 mg KOH/g max).

Notations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6418698-391375-00

ASCENT SOLUTIONS INC.	**Serial#:**	A3S5671	**Mfr:**	WESTINGHOUSE	**Control#:**	6418698
14719 BAYHAM DR, RR#3	**Location:**	NOTL DS-T1	**kV:**	115.5	**Order#:**	391375
	Equipment:	TRANSFORMER	**kVA:**	25000	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1983	**Received:**	05/15/2012
ATTN: WARNER ARDELT	**Breathing:**	SEAL	**Syringe ID:**	8000694	**Reported:**	05/24/2012
PO#: AS1-128692	**Bank:** NA	**Phase:** 3	**Bottle ID:**	A3S5671		
Project ID: 24743LSP	**Fluid:** MIN	**USGal:** 20473	**Sampled By:**	DB		
Customer ID: T1						

	Lab Control Number:	6418698	6406014	6381969	6271839	6138757
	Date Sampled:	05/09/2012	04/02/2012	01/18/2012	03/24/2011	04/06/2010
	Order Number:	391375	388493	383108	359663	332091
	Oil Temp:	35	20		15	40
	Color Number and Visual:	Diagnostic not applicable. Diagnostic not applicable.				
	Dielectric Breakdown D-877:	Diagnostic not applicable.				
Comment:						
Furanic Compound	**2-Furaldehyde (ppb):**	19				
D-5837	**5-Hydroxy-methyl-furaldehyde (ppb):**	< 10				
	2-Acetylfuran (ppb):	< 10				
	5-Methyl-2-furaldehyde (ppb):	< 10				
	2-Furyl alcohol (ppb):	< 10				

Furanic Compound Diagnostics (most recent sample):

New insulation with a high degree of mechanical strength will typically have a Degree of Polymerization (DP) of 1000-1300. "Middle Aged" paper is approximately 500 and paper with less than 250 is in its "Old Age." Severely degraded insulation with a DP of 150 or less will have very little mechanical strength and may result in a transformer failure. The above estimations are based on a study by Chendong of GSU transformers filled with mineral oil.

Estimated Average Degree of Polymerization (DP): 921

Estimated Operating Age of the Equipment: 2

Notations:

Comment:		
PCB	**Concentration (ppm):**	< 1.0 PPM
ASTM Method D-4059	**PCB Type (Arocolor):**	ND
	Reporting Limit:	1.0
Comment:		

End of Test Report

Authorized By: _____

Notations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

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TEST REPORT
01-6418695-391375-00

\SCENT SOLUTIONS INC.	**Serial#:**	A3S5672	**Mfr:**	WESTINGHOUSE	**Control#:**	6418695
14719 BAYHAM DR, RR#3	**Location:**	NOTL DS-T2	**kV:**	115.5	**Order#:**	391375
	Equipment:	TRANSFORMER	**kVA:**	25000	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1983	**Received:**	05/15/2012
ATTN: WARNER ARDELT	**Breathing:**	SEAL	**Syringe ID:**	8003031	**Reported:**	05/24/2012
PO#: AS1-128692	**Bank:** NA	**Phase:** 3	**Bottle ID:**	A3S5672		
Project ID: 24743LSP	**Fluid:** MIN	**USGal:** 20473	**Sampled By:**	DB		
Customer ID: T2						

	Lab Control Number:	6418695	6406012	6381970	6271835	6138752
	Date Sampled:	05/09/2012	04/02/2012	01/11/2012	03/24/2011	04/06/2010
	Order Number:	391375	388493	383108	359663	332091
	Oil Temp:	30	20		15	20
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (ppm):**	97	83		96	118
ASTM	**Methane (CH4) (ppm):**	18	18		17	18
D-3612	**Ethane (C2H6) (ppm):**	15	15		13	15
	Ethylene (C2H4) (ppm):	39	26		20	31
	Acetylene (C2H2) (ppm):	<1	<1		<1	<1
	Carbon Monoxide (CO) (ppm):	**831**	**881**		**733**	**858**
	Carbon Dioxide (CO2) (ppm):	**4114**	**5615**		**4509**	**4984**
	Nitrogen (N2) (ppm):	74831	76615		71174	83529
	Oxygen (O2) (ppm):	3670	3226		2549	5534
	Total Dissolved Gas (TDG) (ppm):	83615	86479		79111	95087
	Total Dissolved Combustible Gas (TDCG) (ppm):	**1000**	**1023**		**879**	**1040**
	Equivalent TCG (%):	0.9999	0.993		0.9574	0.9512

DGA Diagnostics	**DGA Keys Gas / Interpretive Method:** **PER IEEE C57.104-2008** (most recent sample)	Hydrogen within condition 1 limits (100 ppm). Methane within condition 1 limits (120 ppm). Ethane within condition 1 limits (65 ppm). Ethylene within condition 1 limits (50 ppm). Acetylene within condition 1 limits (1 ppm). Carbon Monoxide: Condition 3 Indications of significantly overheated cellulose insulation (570 ppm). Carbon Dioxide: Condition 3 Significant Indications of overheated cellulose insulation (4000 ppm). TDCG: Condition 2 Levels exceed normal concentrations. Fault may be present (720 ppm).
	DGA TDCG Rate Interpretive Method: **PER IEEE C57.104-2008** (two most recent sample)	Retest Quarterly. Exercise caution. Analyze for individual gases. Determine load dependence.
	DGA Cellulose (Paper) Insulation:	CO2/CO Ratio not applicable - neither gas exceeds its limit.
	WDS DGA Condition Code:	NORMAL
	WDS Recommended Action:	Continue normal operation. Resample for testing within one year.

Comment:

General Oil Quality (GOQ)						
D-1533	**Moisture in Oil**	**(ppm):**	3	5	4	4
D-971	**Interfacial Tension**	**(dynes/cm):**	40.66	38.98	41.3	39.7
D-974	**Acid Number**	**(mg KOH/g):**	0.021	0.026	0.015	0.012
D-1500	**Color Number**	**(Relative):**	L1.5	1.0	L1.5	L1.5
D-1524	**Visual Exam.**	**(Relative):**	CLR&SPRK	CLR&SPRK	CLR&SPRK	CLR&SPRK
D-1524	**Sediment Exam.**	**(Relative):**	ND	ND	ND	ND
D-877	**Dielectric Breakdown**	**(kV):**	45	45	42	50
D-1298	**Specific Gravity**	**(Relative):**	0.8628	0.8636	0.867	0.867

GOQ Diagnostics	**Moisture in Oil:**	Acceptable for in-service oil (25 ppm max).
PER IEEE C57.106-2006	**Interfacial Tension:**	Acceptable for in-service oil (30 dynes/cm min).

Notations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

WEIDMANN

WEIDMANN DIAGNOSTIC SOLUTIONS
919 FRASER DR. UNIT 13 + BURLINGTON, ON + L7L 4X8
905-632-8697 + 905-632-8698
WWW.WEIDMANN-DIAGNOSTICS.COM

TEST REPORT
01-6418695-391375-00

ASCENT SOLUTIONS INC.	**Serial#:**	A3S5672	**Mfr:**	WESTINGHOUSE	**Control#:**	6418695
14719 BAYHAM DR, RR#3	**Location:**	NOTL DS-T2	**kV:**	115.5	**Order#:**	391375
	Equipment:	TRANSFORMER	**kVA:**	25000	**Account:**	6312
TILSONBURG, ON N4G 4G8 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1983	**Received:**	05/15/2012
ATTN: WARNER ARDELT	**Breathing:**	SEAL	**Syringe ID:**	8003031	**Reported:**	05/24/2012
PO#: AS1-128692	**Bank:** NA	**Phase:** 3	**Bottle ID:**	A3S5672		
Project ID: 24743LSP	**Fluid:** MIN	**USGal:** 20473	**Sampled By:**	DB		
Customer ID: T2						

	Lab Control Number:	6418695	6406012	6381970	6271835	6138752
	Date Sampled:	05/09/2012	04/02/2012	01/11/2012	03/24/2011	04/06/2010
	Order Number:	391375	388493	383108	359663	332091
	Oil Temp:	30	20		15	20
(most recent sample)	**Acid Number:**	Acceptable for in-service oil (0.15 mg KOH/g max).				
	Color Number and Visual:	Diagnostic not applicable. Diagnostic not applicable.				
	Dielectric Breakdown D-877:	Diagnostic not applicable.				
Comment:						
Furanic Compound	**2-Furaldehyde (ppb):**	11				
D-5837	**5-Hydroxy-methyl-furaldehyde (ppb):**	< 10				
	2-Acetylfuran (ppb):	< 10				
	5-Methyl-2-furaldehyde (ppb):	< 10				
	2-Furyl alcohol (ppb):	< 10				

Furanic Compound Diagnostics (most recent sample):

New insulation with a high degree of mechanical strength will typically have a Degree of Polymerization (DP) of 1000-1300. "Middle Aged" paper is approximately 500 and paper with less than 250 is in its "Old Age." Severely degraded insulation with a DP of 150 or less will have very little mechanical strength and may result in a transformer failure. The above estimations are based on a study by Chendong of GSU transformers filled with mineral oil.

Estimated Average Degree of Polymerization (DP): 995

Estimated Operating Age of the Equipment: <1.0

Notations:

Comment:		
PCB	**Concentration (ppm):**	< 1.0 PPM
ASTM Method D-4059	**PCB Type (Arocolor):**	ND
	Reporting Limit:	1.0
Comment:		

End of Test Report

Authorized By: _____

Notations: 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test.

TRANSFORMER DATA SHEET (Pg. 1 of 4)

Ascent™

System ID NOTL DS **Device ID** T1

Customer	NIAGARA ON THE LAKE HYDRO	Date	May 8, 2012
Customer Address	8 HENEGAN ROAD, VIRGIL	Job #	24743LSP
Site	NOTL DS		
Site Address	801 CONCESSION 5, VIRGIL		

Nameplate Data

Transformer Class	Unit Padmount		Padmount		Station	X			Other
Transformer Cooling	ONAN	X	ONAF	X	LNAN		DRY		Other
Bushing Configuration	Dead Front		Top - Top	X	Top - Side		Side - Side		Other

Manufacturer	WESTINGHOUSE		Core & Windings	27215	kg	X	lb	
Date of Manufacture	1983		Tanks & Fittings	12643	kg	X	lb	
Serial #	A355671		Coolant Volume	20473	L	X	Gal	
KVA / Prov. KVA Rating	15, 20, 25	MVA	Coolant Weight	17772	kg	X	lb	
Primary Voltage	115500	V	Total Weight	57630	kg	X	lb	
Primary Ampacity	125	A	Temperature Rise	55	°C	X	°F	
Secondary Voltage	29500	V	HV BIL Rating	550	kV			
Secondary Ampacity	489	A	LV BIL Rating	150	kV			
HV Winding Material	NA		Percent Impedance	8.6 / 8.9 %	ONAN		ONAF	X
LV Winding Material	NA		Tamper Resistant		YES		NO	X
CSA Specification(s)	NA		Transformer Colour	GREY				
Comments								

Visual Inspection

Nameplate Condition	Satisfactory	√	Not Satisfactory		N/A		Comments
Fan / Pump Operation	Satisfactory	√	Not Satisfactory		N/A		Comments
Ground Connections	Satisfactory	√	Not Satisfactory		N/A		Comments
Liquid Levels In Tanks	Satisfactory	√	Not Satisfactory		N/A		Comments
Interlock Operation	Satisfactory		Not Satisfactory		N/A	√	Comments
Temp. Gauge Operation	Satisfactory	√	Not Satisfactory		N/A		Comments

Coolant Temperature	20	°C	X	°F		Max. Coolant Temperature	35	°C	X	°F	

Comments

Oil Conservator

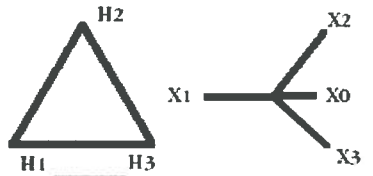
Oil Conservator	Yes		No	X		Conservator Volume		L		Gal	
Silica Gel Breather	Yes		No			Breather Volume		L		Gal	
Silica Gel Colour	Good		Bad		Replaced		N/A	X			

Comments

Tap Changer Data

Position / Designation		Tap Voltages (V)	As Found	As Left
1 / A	105.00%	26550		
2 / B	102.50%	26918		
3 / C	100.00%	27288		
4 / D	97.50%	27656	4	4
5 / E	95.00%	28025		

Vector Diagram



Primary Vector X Secondary Vector X

Comments: ADDITIONAL TRANSFORMER SECONDARY SIDE TAP CHANGER POSITIONS:
6/F = 28395 V, 7/G = 28763 V, 8/H = 29131 V, 9/I = 29500 V, 10/J = 29869 V, 11/K = 30238 V

Tested By: DAVE BENJAMIN

TRANSFORMER DATA SHEET (Pg. 2 of 4)

System ID: NOTL DS Device ID: T1

Neutral Grounding Resistor (NGR)

NGR Present: Yes [ ] No [X]

Manufacturer: _____ NGR Serial #: _____

NGR Voltage: _____ V Maximum Current: _____ A

NGR Resistance: _____ Ω NGR Location: _____

Comments: _____

Transformer Lightning Arrestors

Class: Distribution [ ] Intermediate [X] Station [ ]

Composition: Ceramic [ ] Polymer [X]

Manufacturer: GE TRANQUELL Max. / MCOV Rating: 21.0 / 17.0 kV

Catalog #: 9L12PPA021S

Comments: LV SIDE OF TRANSFORMER

Interlock

Key Interlock: Yes [ ] No [X]

Interlock Type: Elec. [ ] Mech. [ ] Utility Lock [ ]

Devices Interlocked: H.V. Switch [ ] Breaker [ ] Trans. Encl. [ ] Other [ ] _____

Manufacturer: _____ Key Interlock #: _____

Comments: _____

Fans

of Fans: 10 Fan Voltage: _____

Fan Size: 24"-28" Frame Size: _____

Horsepower: 25 HP

Comments: _____

Transformer Load Side Conductor Data

Conductor Type: Cable [ ] Bus Bar [ ] Conductor Size / Dim.: _____

Conductor Material: Aluminum [ ] Copper [ ] Conductors per Phase: _____ / Phase

Tape Shield: Aluminum [ ] Copper [ ] Bond Size / Dim.: _____

Concentric Neutral: Aluminum [ ] Copper [ ] # of Bond Conductors: _____

Insulation Voltage: _____ # of Neutral Conductors: _____

Insulation Type: _____ Neutral Size / Dim.: _____

Comments: NA

Tested By: DAVE BENJAMIN

TRANSFORMER TEST SHEET (Pg. 3 of 4)

System ID	NOTL DS	Device ID	T1

Electrical Tests

Turn Ratio Test

Tap Position / Designation		Tap Voltage (V)	Calculated Ratio	H 1 To H 2 X 0 To X 2	H 2 To H 3 X 0 To X 3	H 3 To H 1 X 0 To X 1
1 / A	105.00%	26550				
2 / B	102.50%	26918				
3 / C	100.00%	27288				
4 / D	97.50%	27656	7.233	7.253	7.255	7.250
5 / E	95.00%	28025				

		Excitation Currrent	Percent Deviation	Excitation Currrent	Percent Deviation	Excitation Currrent	Percent Deviation
Tap Position As Found	4	0.10 mA	%	0.70 mA	%	0.11 mA	%
Tap Position As Left		mA	%	mA	%	mA	%

Primary Winding Resistance

Resistance in ohms at 1 A after 1 minute

H0 - H1	NA	Ω	H1 - H2	2.663	Ω
H0 - H2	NA	Ω	H2 - H3	2.658	Ω
H0 - H3	NA	Ω	H3 - H1	2.659	Ω

Stabilization Time > 1 Minute

Secondary Winding Resistance

Resistance in milli-ohms at 10 A after 1 minute

X0 - X1	75.81	mΩ	X1 - X2	150.70	mΩ
X0 - X2	75.83	mΩ	X2 - X3	150.90	mΩ
X0 - X3	75.80	mΩ	X3 - X1	150.80	mΩ

Stabilization Time > 1 Minute

Capacitance Test

	Low - Ground		Low - Guard		UST (High - Low)		High - Guard		High - Ground	
Capacitance in pico-farads	6427	pF	2044	pF	4388	pF	9568	pF	13948	pF
Uncorrected D.F. (%)	0.222	%	0.327	%	0.173	%	0.423	%	0.375	%
Corrected to 20 °C (%)	0.222	%	0.327	%	0.173	%	0.423	%	0.375	%

Temp. Correction Factor 1

Lightning Arrestor Insulation Resistance

Resistance in meg-ohms @ 10000 V DC after 1 minute

Phase A to Ground	11700	MΩ
Phase B to Ground	11000	MΩ
Phase C to Ground	7590	MΩ

Secondary Conductor Insulation Resistance

Resistance in meg-ohms @ NA V DC after 1 minute

Phase A to Ground	NA	MΩ	Phase A to Phase B	NA	MΩ
Phase B to Ground	NA	MΩ	Phase B to Phase C	NA	MΩ
Phase C to Ground	NA	MΩ	Phase C to Phase A	NA	MΩ

Comments / Observations

Test Instrument(s)	Manufacturer / Model	Ratio	Winding	Cap Bridge	Megger	
	Serial #	0311	0510	5374	1025	

Tested By: DAVE BENJAMIN

TRANSFORMER TEST SHEET (Pg. 4 of 4)

System ID: NOTL DS Device ID: T1

Dielectric Absorption Test (Insulation Resistance)

Time	High to Low & Gnd Uncorrected	High to Low & Gnd Corrected	Low to High & Gnd Uncorrected	Low to High & Gnd Corrected	High & Low to Gnd Uncorrected	High & Low to Gnd Corrected
15 sec	3550 MΩ	3550 MΩ	1950 MΩ	1950 MΩ	3900 MΩ	3900 MΩ
30 sec	3920 MΩ	3920 MΩ	2360 MΩ	2360 MΩ	4780 MΩ	4780 MΩ
45 sec	4260 MΩ	4260 MΩ	2530 MΩ	2530 MΩ	5160 MΩ	5160 MΩ
1 min	4610 MΩ	4610 MΩ	2770 MΩ	2770 MΩ	5740 MΩ	5740 MΩ
2 min	5600 MΩ	5600 MΩ	3520 MΩ	3520 MΩ	6740 MΩ	6740 MΩ
3 min	6350 MΩ	6350 MΩ	4100 MΩ	4100 MΩ	7290 MΩ	7290 MΩ
4 min	6850 MΩ	6850 MΩ	4620 MΩ	4620 MΩ	7650 MΩ	7650 MΩ
5 min	7310 MΩ	7310 MΩ	4930 MΩ	4930 MΩ	7980 MΩ	7980 MΩ
6 min	7630 MΩ	7630 MΩ	5290 MΩ	5290 MΩ	8150 MΩ	8150 MΩ
7 min	7920 MΩ	7920 MΩ	5550 MΩ	5550 MΩ	8300 MΩ	8300 MΩ
8 min	8190 MΩ	8190 MΩ	5790 MΩ	5790 MΩ	8460 MΩ	8460 MΩ
9 min	8350 MΩ	8350 MΩ	6000 MΩ	6000 MΩ	8600 MΩ	8600 MΩ
10 min	8530 MΩ	8530 MΩ	6220 MΩ	6220 MΩ	8720 MΩ	8720 MΩ
Test Voltage	10000 V		10000 V		10000 V	
Multiplier	1		1		1	
Polarization Index	1.85		2.25		1.52	
TCC 1.00	Insulation Resistance Readings Corrected to 20 °C					

Insulation Resistance

Resistance in meg-ohms after 1 minute.

High to Low & Ground	4610	MΩ @	10000	V
Low to High & Ground	2770	MΩ @	10000	V
High & Low to Ground	5740	MΩ @	10000	V

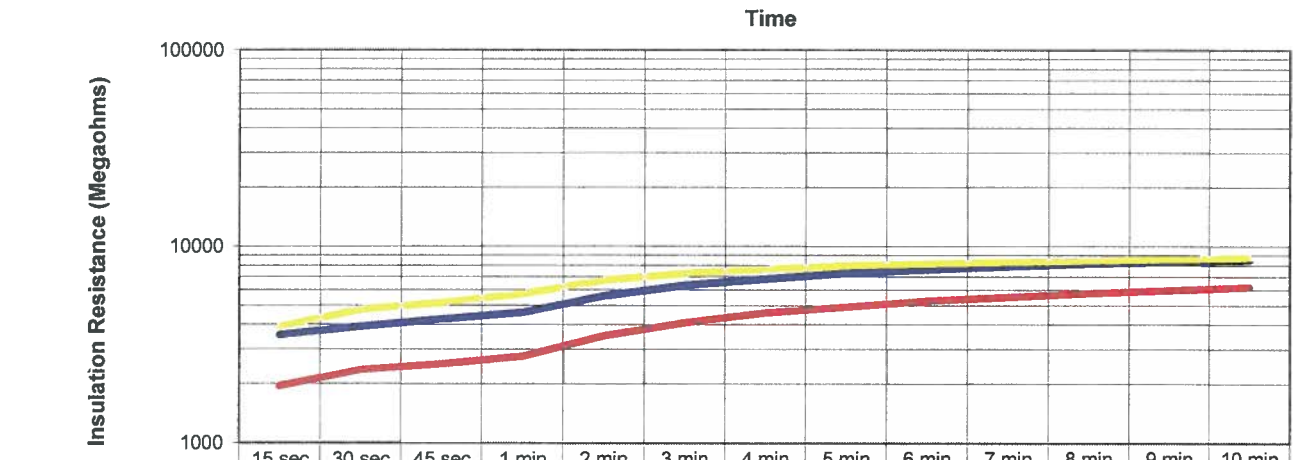
Core Ground Insulation Resistance

Resistance in meg-ohms after 1 minute.

Core Ground Accessible: Yes ☐ No ☐

Test Voltage: 500 V

Core Ground Resistance: MΩ



	15 sec	30 sec	45 sec	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min
High to Low & Gnd	3550	3920	4260	4610	5600	6350	6850	7310	7630	7920	8190	8350	8530
Low to High & Gnd	1950	2360	2530	2770	3520	4100	4620	4930	5290	5550	5790	6000	6220
High & Low to Gnd	3900	4780	5160	5740	6740	7290	7650	7980	8150	8300	8460	8600	8720

Test Instrument(s) Manufacturer / Model: Megger

Serial #: 1025

Comments:

Tested By: DAVE BENJAMIN

TRANSFORMER DATA SHEET (Pg. 1 of 4)

Ascent™

System ID NOTL DS **Device ID** T2

Customer	NIAGARA ON THE LAKE HYDRO	Date	May 9, 2012
Customer Address	8 HENEGAN ROAD, VIRGIL	Job #	24743LSP
Site	NOTL DS		
Site Address	801 CONCESSION 5, VIRGIL		

Nameplate Data

Transformer Class	Unit Padmount		Padmount		Station			Other
Transformer Cooling	ONAN		ONAF	X	LNAN		DRY	Other
Bushing Configuration	Dead Front		Top - Top		Top - Side		Side - Side	Other

Manufacturer	WESTINGHOUSE		Core & Windings	27215	kg	X	lb	
Date of Manufacture	1983		Tanks & Fittings	12643	kg	X	lb	
Serial #	A355672		Coolant Volume	20473	L	X	Gal	
KVA / Prov. KVA Rating	15, 20, 25	MVA	Coolant Weight	17772	kg	X	lb	
Primary Voltage	115500	V	Total Weight	57630	kg	X	lb	
Primary Ampacity	125	A	Temperature Rise	55	°C	X	°F	
Secondary Voltage	29500	V	HV BIL Rating	550	kV			
Secondary Ampacity	489	A	LV BIL Rating	150	kV			
HV Winding Material	NA		Percent Impedance	8.56 / 8.46 %	ONAN	X	ONAF	X
LV Winding Material	NA		Tamper Resistant		YES		NO	X
CSA Specification(s)	NA		Transformer Colour	GREY				
Comments								

Visual Inspection

Nameplate Condition	Satisfactory	√	Not Satisfactory		N/A		Comments
Fan / Pump Operation	Satisfactory	√	Not Satisfactory		N/A		Comments
Ground Connections	Satisfactory	√	Not Satisfactory		N/A		Comments
Liquid Levels In Tanks	Satisfactory	√	Not Satisfactory		N/A		Comments
Interlock Operation	Satisfactory		Not Satisfactory		N/A	√	Comments
Temp. Gauge Operation	Satisfactory	√	Not Satisfactory		N/A		Comments

Coolant Temperature	30	°C	X	°F	Max. Coolant Temperature	40	°C	X	°F
Comments								

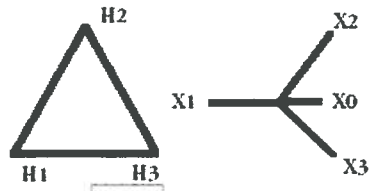
Oil Conservator

Oil Conservator	Yes		No	X		Conservator Volume	L	Gal
Silica Gel Breather	Yes		No			Breather Volume	L	Gal
Silica Gel Colour	Good		Bad		Replaced	N/A		
Comments								

Tap Changer Data

Position / Designation		Tap Voltages (V)	As Found	As Left
1 / A	105.00%	26550		
2 / B	102.50%	26918		
3 / C	100.00%	27288	3	3
4 / D	97.50%	27656		
5 / E	95.00%	28025		

Vector Diagram



Primary Vector X Secondary Vector X

Comments: ADDITIONAL TRANSFORMER SECONDARY SIDE TAP CHANGER POSITIONS:
6/F = 28395 V, 7/G = 28763 V, 8/H = 29131 V, 9/I = 29500 V, 10/J = 29869 V, 11/K = 30238 V

Tested By: DAVE BENJAMIN

System ID: NOTL DS Device ID: T2

Neutral Grounding Resistor (NGR)

NGR Present: Yes [ ] No [X]
Manufacturer: NGR Serial #:
NGR Voltage: V Maximum Current: A
NGR Resistance: Ω NGR Location:
Comments:

Transformer Lightning Arrestors

Class: Distribution [ ] Intermediate [X] Station [ ]
Composition: Ceramic [ ] Polymer [X]
Manufacturer: GE TRANQUELL Max. / MCOV Rating: 21.0 / 17.0 kV
Catalog #: 9L12PPA021S
Comments: LV SIDE OF TRANSFORMER

Interlock

Key Interlock: Yes [ ] No [X]
Interlock Type: Elec. [ ] Mech. [ ] Utility Lock [ ]
Devices Interlocked: H.V. Switch [ ] Breaker [ ] Trans. Encl. [ ] Other [ ]
Manufacturer: Key Interlock #:
Comments:

Fans

of Fans: Fan Voltage:
Fan Size: Frame Size:
Horsepower:
Comments:

Transformer Load Side Conductor Data

Conductor Type: Cable [ ] Bus Bar [ ] Conductor Size / Dim.:
Conductor Material: Aluminum [ ] Copper [ ] Conductors per Phase: / Phase
Tape Shield: Aluminum [ ] Copper [ ] Bond Size / Dim.:
Concentric Neutral: Aluminum [ ] Copper [ ] # of Bond Conductors:
Insulation Voltage: # of Neutral Conductors:
Insulation Type: Neutral Size / Dim.:
Comments:

Tested By: DAVE BENJAMIN

TRANSFORMER TEST SHEET (Pg. 3 of 4)

System ID: NOTL DS Device ID: T2

Electrical Tests

Turn Ratio Test

Tap Position / Designation		Tap Voltage (V)	Calculated Ratio	H 1 To H 2 / X 0 To X 2	H 2 To H 3 / X 0 To X 3	H 3 To H 1 / X 0 To X 1
1 / A	105.00%	26550				
2 / B	102.50%	26918				
3 / C	100.00%	27288	7.331	7.349	7.350	7.350
4 / D	97.50%	27656				
5 / E	95.00%	28025				

		Excitation Currrent	Percent Deviation	Excitation Currrent	Percent Deviation	Excitation Currrent	Percent Deviation
Tap Position As Found	3	0.11 mA	NA %	0.07 mA	NA %	0.10 mA	NA %
Tap Position As Left		mA	%	mA	%	mA	%

Primary Winding Resistance

Resistance in ohms at 1 A after 1 minute

H0 - H1	NA Ω	H1 - H2	2.701 Ω
H0 - H2	NA Ω	H2 - H3	2.709 Ω
H0 - H3	NA Ω	H3 - H1	2.708 Ω

Stabilization Time > 1 Minute

Secondary Winding Resistance

Resistance in milli-ohms at 10 A after 1 minute

X0 - X1	77.580 mΩ	X1 - X2	153.200 mΩ
X0 - X2	77.560 mΩ	X2 - X3	154.400 mΩ
X0 - X3	77.230 mΩ	X3 - X1	152.500 mΩ

Stabilization Time > 1 Minute

Capacitance Test

	Low - Ground	Low - Guard	UST (High - Low)	High - Guard	High - Ground
Capacitance in pico-farads	3220 pF	1022 pF	2197 pF	4758 pF	6953 pF
Uncorrected D.F. (%)	0.213 %	0.324 %	0.160 %	0.412 %	0.358 %
Corrected to 20 °C (%)	0.134 %	0.204 %	0.101 %	0.260 %	0.226 %

Temp. Correction Factor 0.63

Lightning Arrestor Insulation Resistance

Resistance in meg-ohms @ 10000 V DC after 1 minute

Phase A to Ground	7890 MΩ
Phase B to Ground	12800 MΩ
Phase C to Ground	29100 MΩ

Secondary Conductor Insulation Resistance

Resistance in meg-ohms @ NA V DC after 1 minute

Phase A to Ground	NA MΩ	Phase A to Phase B	NA MΩ
Phase B to Ground	NA MΩ	Phase B to Phase C	NA MΩ
Phase C to Ground	NA MΩ	Phase C to Phase A	NA MΩ

Comments / Observations

RAINED PRIOR TO CAPACITANCE TESTING - 16°C, 72%

Test Instrument(s) Manufacturer / Model	Ratio	Winding	Cap Bridge	Megger	
Serial #	0311	0510	5374	1025	

Tested By: DAVE BENJAMIN

TRANSFORMER TEST SHEET (Pg. 4 of 4)

System ID	NOTL DS	Device ID	T2

Dielectric Absorption Test (Insulation Resistance)

Time	High to Low & Gnd		Low to High & Gnd		High & Low to Gnd	
	Uncorrected	Corrected	Uncorrected	Corrected	Uncorrected	Corrected
15 sec	3550 MΩ	6390 MΩ	1950 MΩ	3510 MΩ	3900 MΩ	7020 MΩ
30 sec	3920 MΩ	7056 MΩ	2360 MΩ	4248 MΩ	4780 MΩ	8604 MΩ
45 sec	4260 MΩ	7668 MΩ	2530 MΩ	4554 MΩ	5160 MΩ	9288 MΩ
1 min	4610 MΩ	8298 MΩ	2770 MΩ	4986 MΩ	5740 MΩ	10332 MΩ
2 min	5600 MΩ	10080 MΩ	3520 MΩ	6336 MΩ	6740 MΩ	12132 MΩ
3 min	6350 MΩ	11430 MΩ	4100 MΩ	7380 MΩ	7290 MΩ	13122 MΩ
4 min	6850 MΩ	12330 MΩ	4620 MΩ	8316 MΩ	7650 MΩ	13770 MΩ
5 min	7310 MΩ	13158 MΩ	4930 MΩ	8874 MΩ	7980 MΩ	14364 MΩ
6 min	7630 MΩ	13734 MΩ	5290 MΩ	9522 MΩ	8150 MΩ	14670 MΩ
7 min	7920 MΩ	14256 MΩ	5550 MΩ	9990 MΩ	8300 MΩ	14940 MΩ
8 min	8190 MΩ	14742 MΩ	5790 MΩ	10422 MΩ	8460 MΩ	15228 MΩ
9 min	8350 MΩ	15030 MΩ	6000 MΩ	10800 MΩ	8600 MΩ	15480 MΩ
10 min	8530 MΩ	15354 MΩ	6220 MΩ	11196 MΩ	8720 MΩ	15696 MΩ
Test Voltage	10000 V		10000 V		10000 V	
Multiplier	1		1		1	
Polarization Index	1.85		2.25		1.52	
TCC 1.80	Insulation Resistance Readings Corrected to 20 °C					

Insulation Resistance

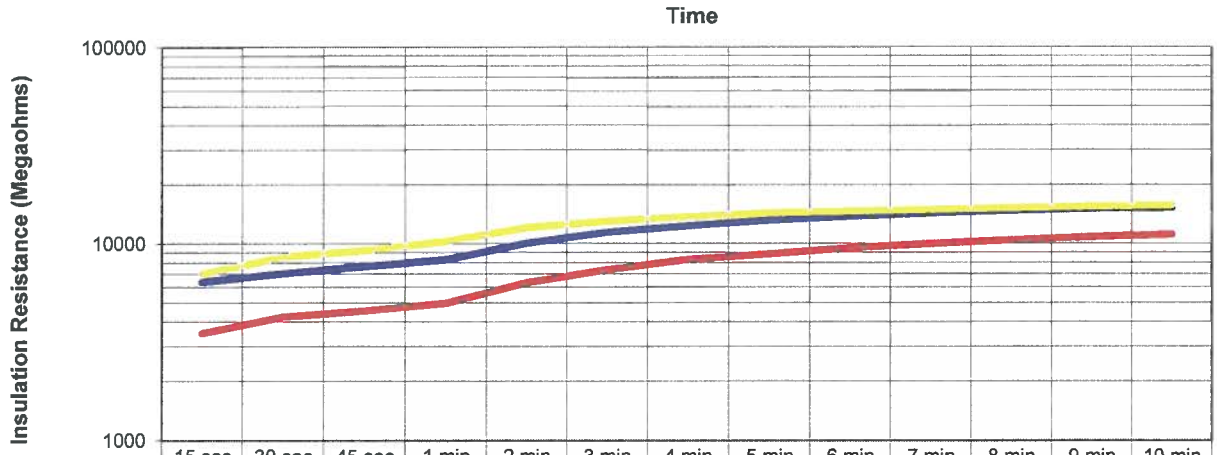
Resistance in meg-ohms after 1 minute.

High to Low & Ground	8298	MΩ @	10000	V
Low to High & Ground	4986	MΩ @	10000	V
High & Low to Ground	10332	MΩ @	10000	V

Core Ground Insulation Resistance

Resistance in meg-ohms after 1 minute.

Core Ground Accessible	Yes ☐	No ☐
Test Voltage	500	V
Core Ground Resistance		MΩ



	15 sec	30 sec	45 sec	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min
High to Low & Gnd	6390	7056	7668	8298	10080	11430	12330	13158	13734	14256	14742	15030	15354
Low to High & Gnd	3510	4248	4554	4986	6336	7380	8316	8874	9522	9990	10422	10800	11196
High & Low to Gnd	7020	8604	9288	10332	12132	13122	13770	14364	14670	14940	15228	15480	15696

Test Instrument(s)	Manufacturer / Model	Megger				
	Serial #	1025				

Comments: WEATHER: RAINY, WET, WINDY

Tested By: DAVE BENJAMIN

WINDING INSULATION POWER FACTOR TEST REPORT

Ascent™

System ID: NOTL DS Device ID: T1

Customer: NIAGARA ON THE LAKE HYDRO
Customer Address: 8 HENEGAN ROAD, VIRGIL
Site: NOTL DS
Site Address: 801 CONCESSION 5, VIRGIL

Date: May 8, 2012
Job #: 24743LSP

Transformer Data

Oil Temperature: 20 °C
Winding Temperature: 20 °C
Temp. Correction Factor: 1

Conditions

Temperature: 13 °C
Humidity: 77 %

Test Data

Test Mode/No.		Insulation Tested	Test Voltage (kV)	Equivalent 10kV Current (mA)	Equivalent 10kV Watts (W)	Measured %PF	Corrected %PF @ 20 deg C	Capacitance (pF)
GST GND	Low-Gnd	CHG+CHL	10K	24.490	0.5530	0.23	0.23	6495
GST	Low-Guard	CHG	10.20K	7.788	0.2328	0.30	0.30	2066
UST	High-Low	CHL	10.02K	16.700	0.3238	0.19	0.19	4429
		ACTUAL						4429
GST GND	High-Gnd	CLG+CHL	10K	53.090	1.7100	0.32	0.32	14087
GST	High-Guard	CLG	10K	36.430	1.3920	0.38	0.38	9662
UST	High-Low	CHL	10K	16.690	0.3255	0.20	0.20	4428
		ACTUAL						4425

Comments / Observations

Test Instrument(s) Manufacturer / Model: MEGGER
Serial #: DELTA 2000

Tested By: DAVE BENJAMIN, MIKE LEFEBVRE

WINDING INSULATION POWER FACTOR TEST REPORT

Ascent™

System ID: NOTL DS Device ID: T2

Customer: NIAGARA ON THE LAKE HYDRO
Customer Address: 8 HENEGAN ROAD, VIRGIL
Site: NOTL DS
Site Address: 801 CONCESSION 5, VIRGIL

Date: May 8, 2012
Job #: 24743LSP

Transformer Data

Oil Temperature: 30 °C
Winding Temperature: 30 °C
Temp. Correction Factor: 0.63

Conditions

Temperature: 17 °C
Humidity: 59 %

Test Data

Test Mode/No.		Insulation Tested	Test Voltage (kV)	Equivalent 10kV Current (mA)	Equivalent 10kV Watts (W)	Measured %PF	Corrected %PF @ 20 deg C	Capacitance (pF)
GST GND	Low-Gnd	CHG+CHL	10.03K	24.490	0.5461	0.22	0.14	6497
GST	Low-Guard	CHG	10.05K	7.770	0.2323	0.30	0.19	2062
UST	High-Low	CHL	10.02K	16.720	0.3176	0.19	0.12	4435
		ACTUAL						4435
GST GND	High-Gnd	CLG+CHL	10.02K	52.930	1.6560	0.31	0.20	14044
GST	High-Guard	CLG	10.05K	36.240	1.3480	0.37	0.23	9613
UST	High-Low	CHL	10.02K	16.720	0.3176	0.19	0.12	4435
		ACTUAL						4431

Comments / Observations

Test Instrument(s) Manufacturer / Model: MEGGER
Serial #: DELTA 2000

Tested By: DAVE BENJAMIN, MIKE LEFEBVRE

SFRA Test Results

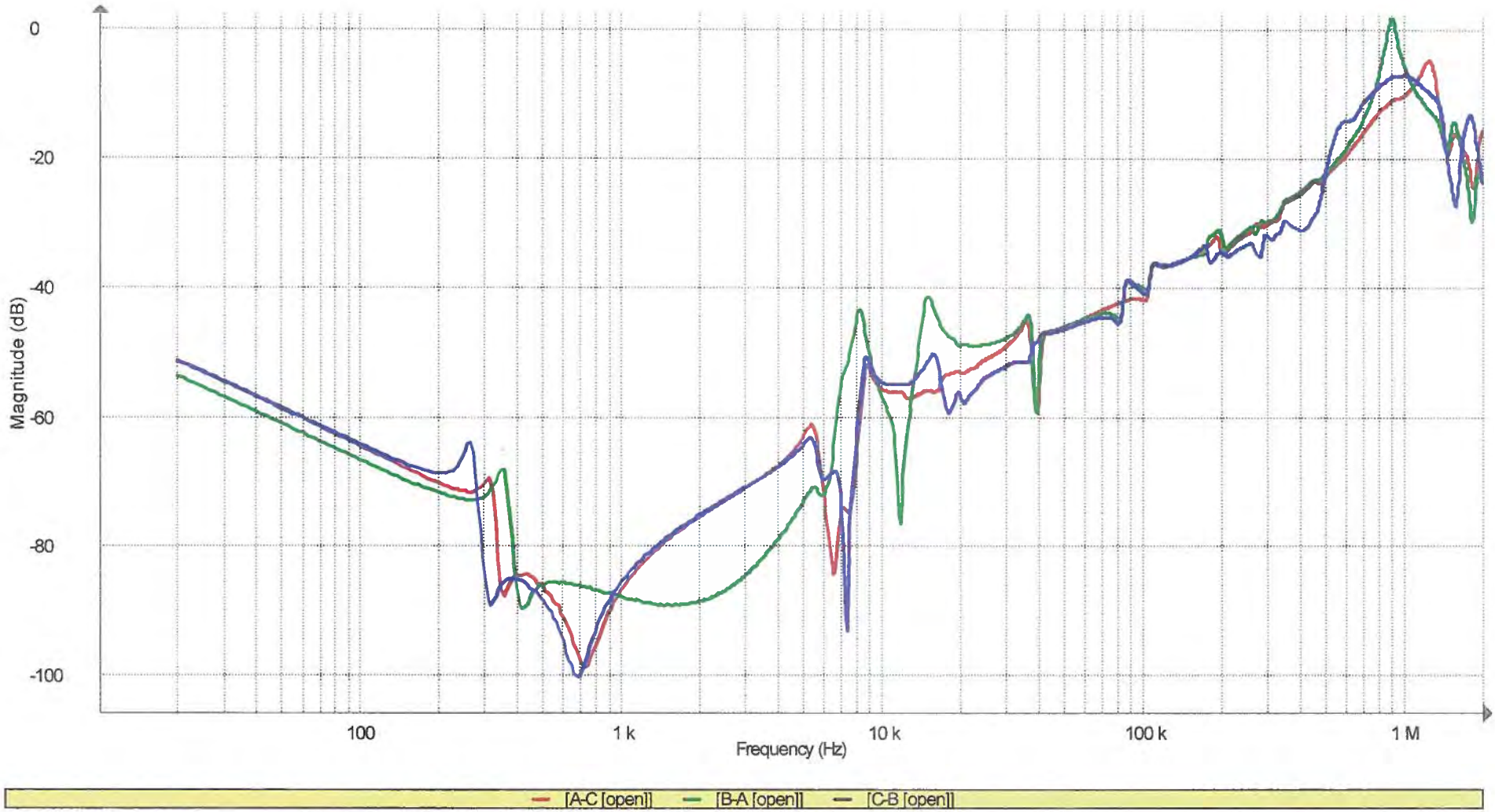
Report date: 2012-06-07

Date of Test: 5/8/2012	**Time of Test:** 11:40:55
Company Name: Ascent	**Location:** NOTL DS
Test Object: NOTL T1	**Manufacturer:** Westinghouse
Serial Number: A 3S-5671	**Built Year:** 1983
Phase Design: 3	**Winding Configuration:**
KV Rating: 150000	**KVA Rating:** 15-20-25
NLTC Position: 4	**LTC Position:** Position 4
Temperature: 15	**Reason For Test:** Assessment Analysis
Tested By: Dave Benjamin	
Notes:	

Transformer: "NOTL T1" **at** "NOTL DS"
Serial Number: A 3S-5671
Tested 5/8/2012 **at** 11:40:55

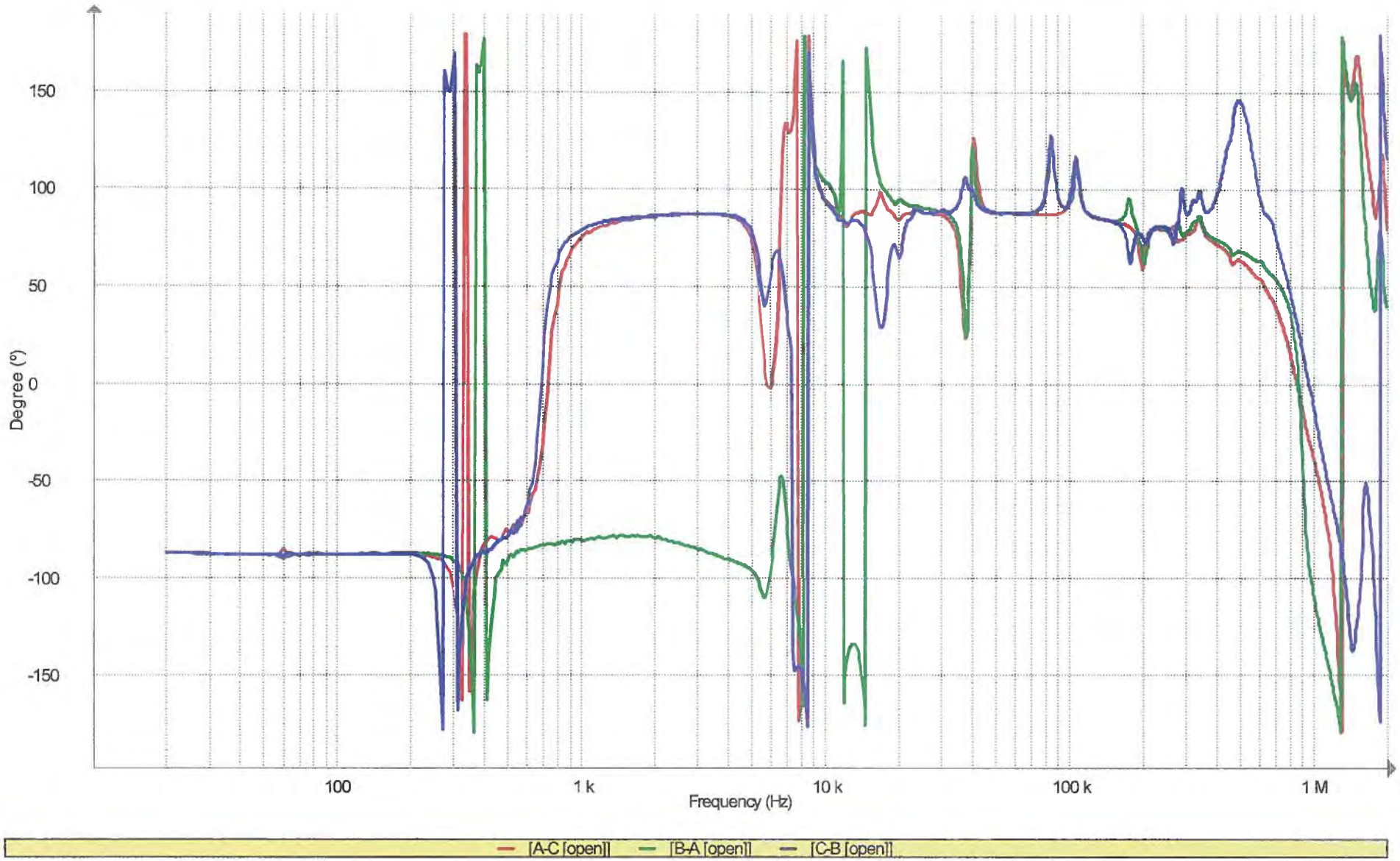
Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



 Report generated by FRAX software

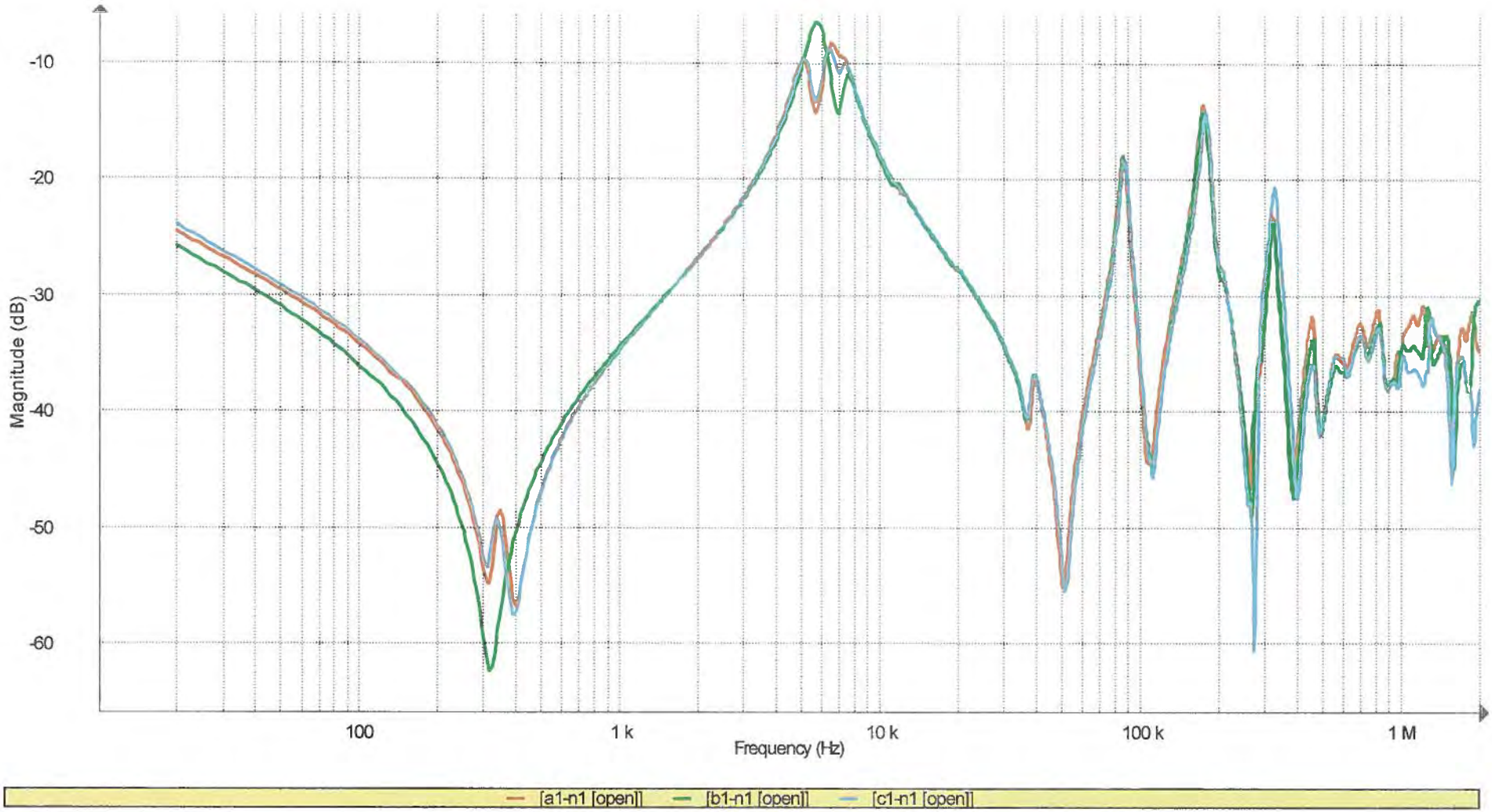
Phase:



Transformer: "NOTL T1" **at** "NOTL DS"
Serial Number: A 3S-5671
Tested 5/8/2012 **at** 11:40:55

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



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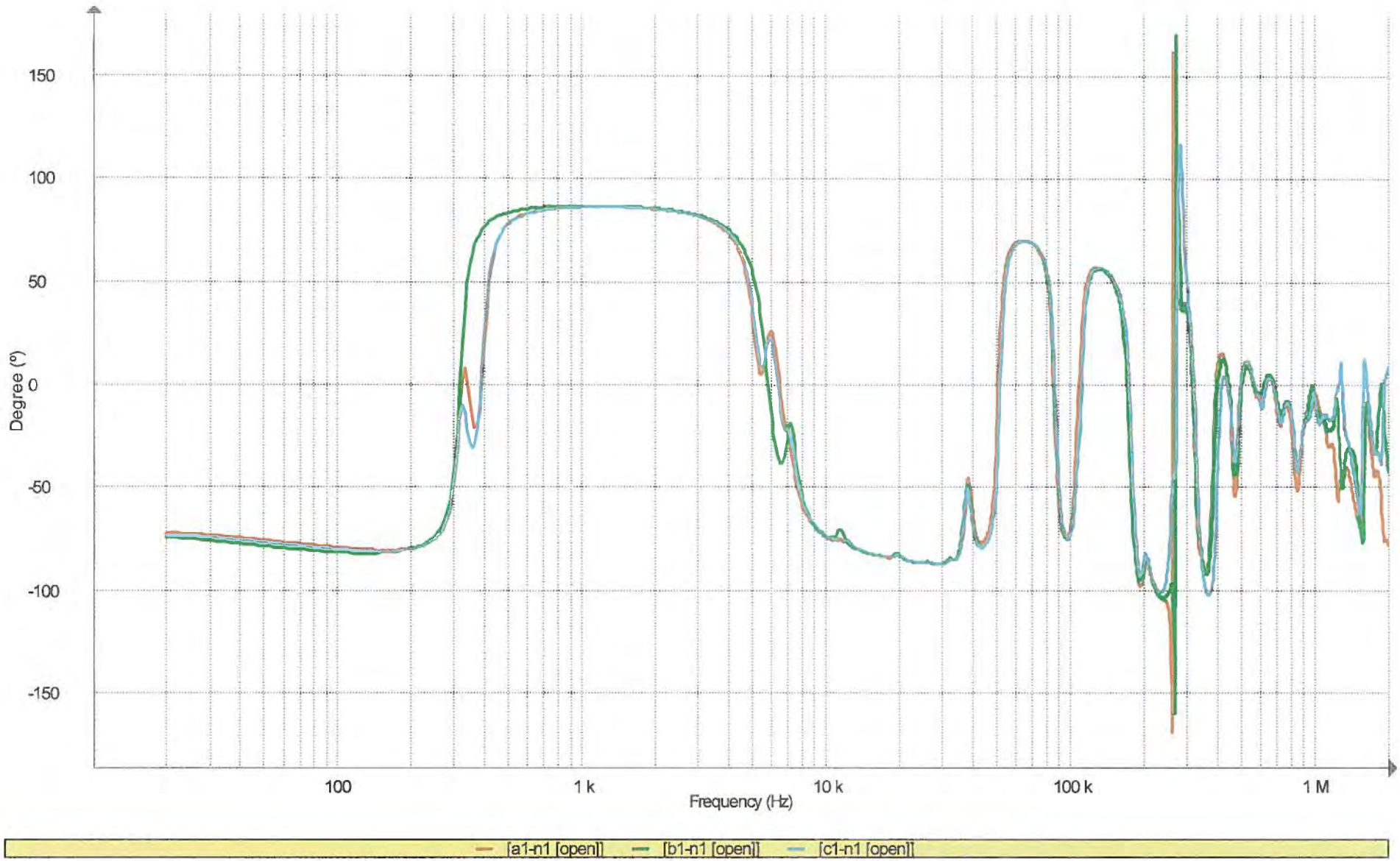
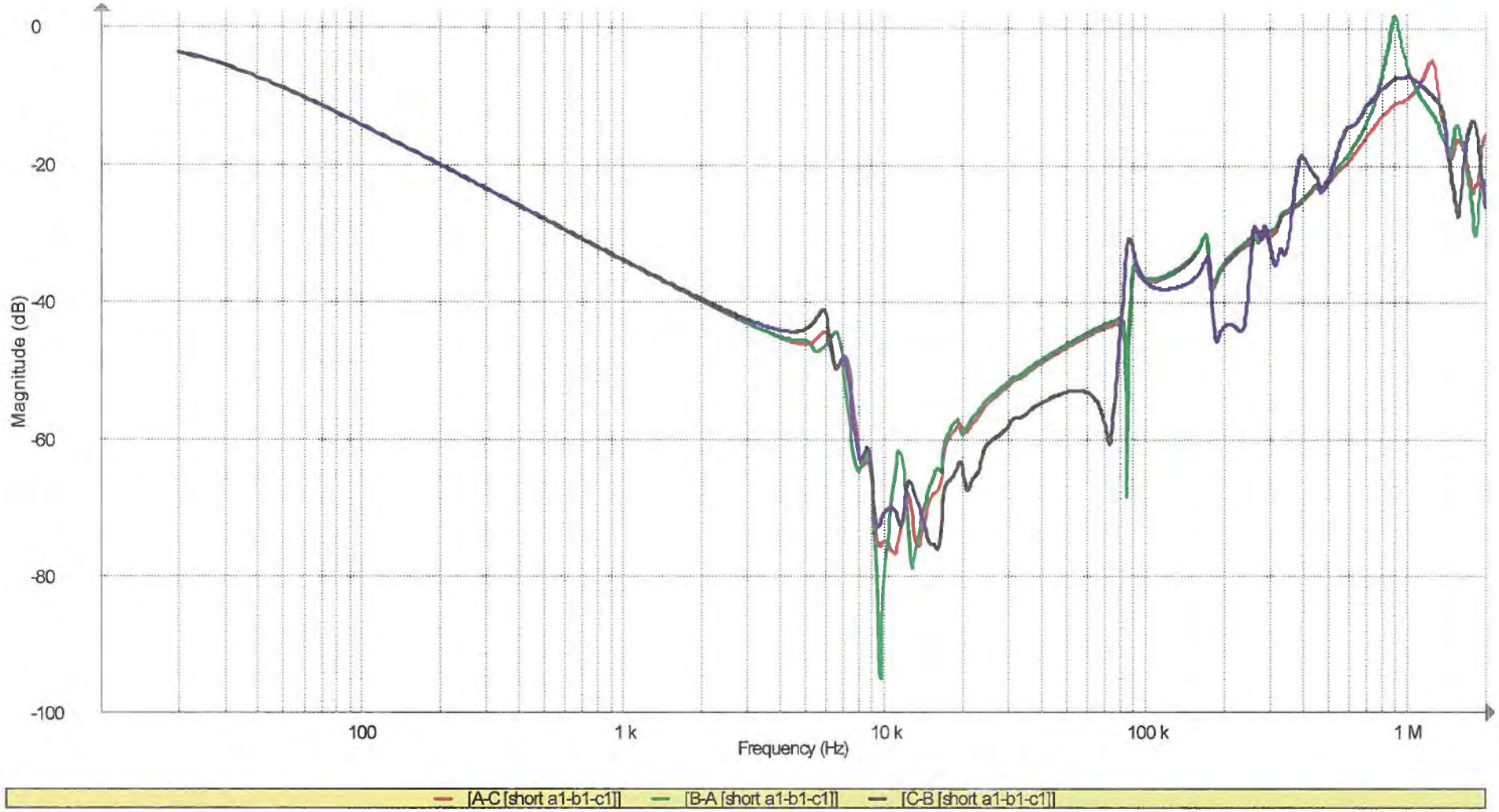


Transformer: "NOTL T1" **at** "NOTL DS"
Serial Number: A 3S-5671
Tested 5/8/2012 **at** 11:40:55

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



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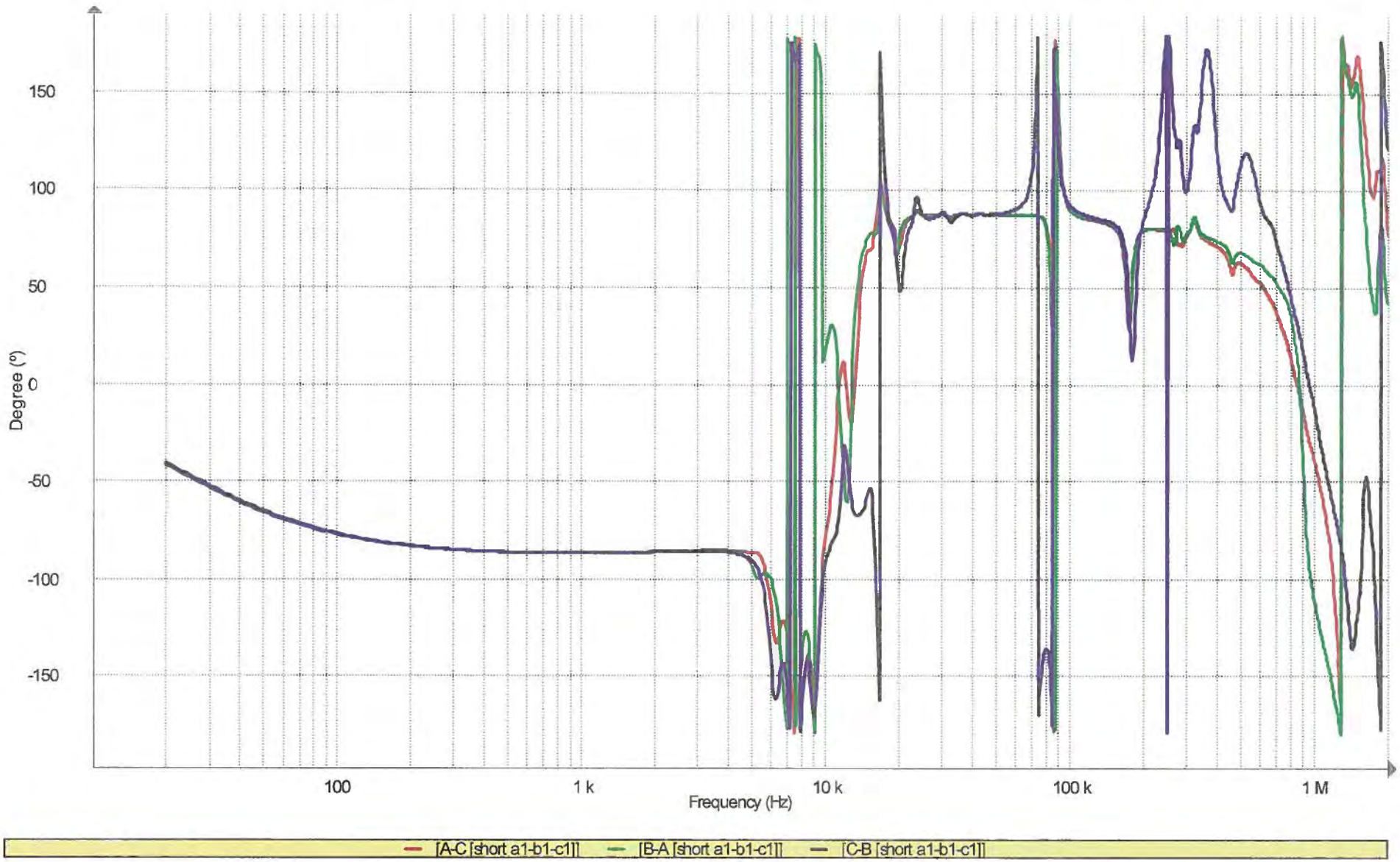
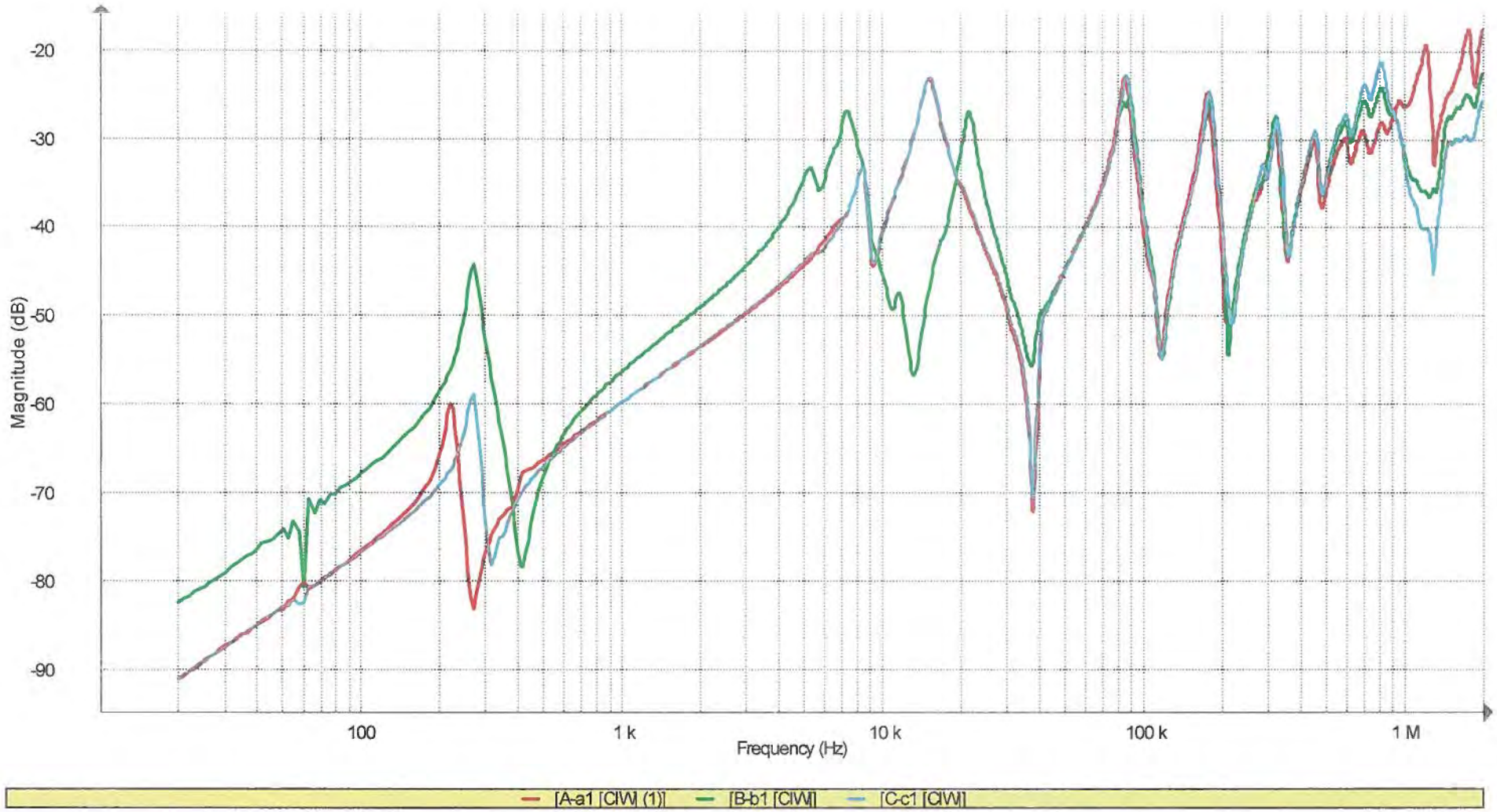


Transformer: "NOTL T1" **at** "NOTL DS"
Serial Number: A 3S-5671 **Manufacturer:** Westinghouse
Tested 5/8/2012 **at** 11:40:55 **Tested by:** Dave Benjamin

Magnitude:



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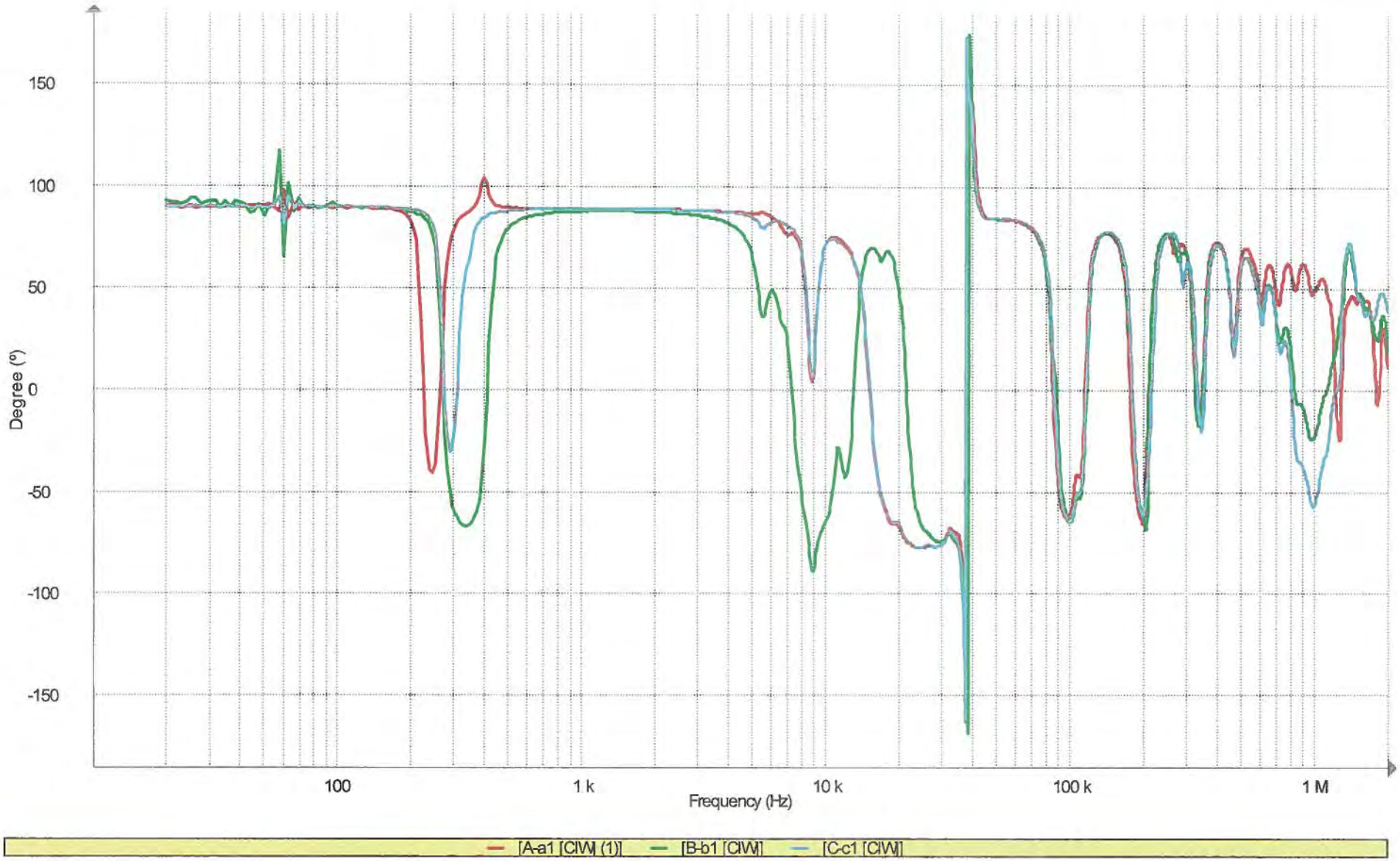
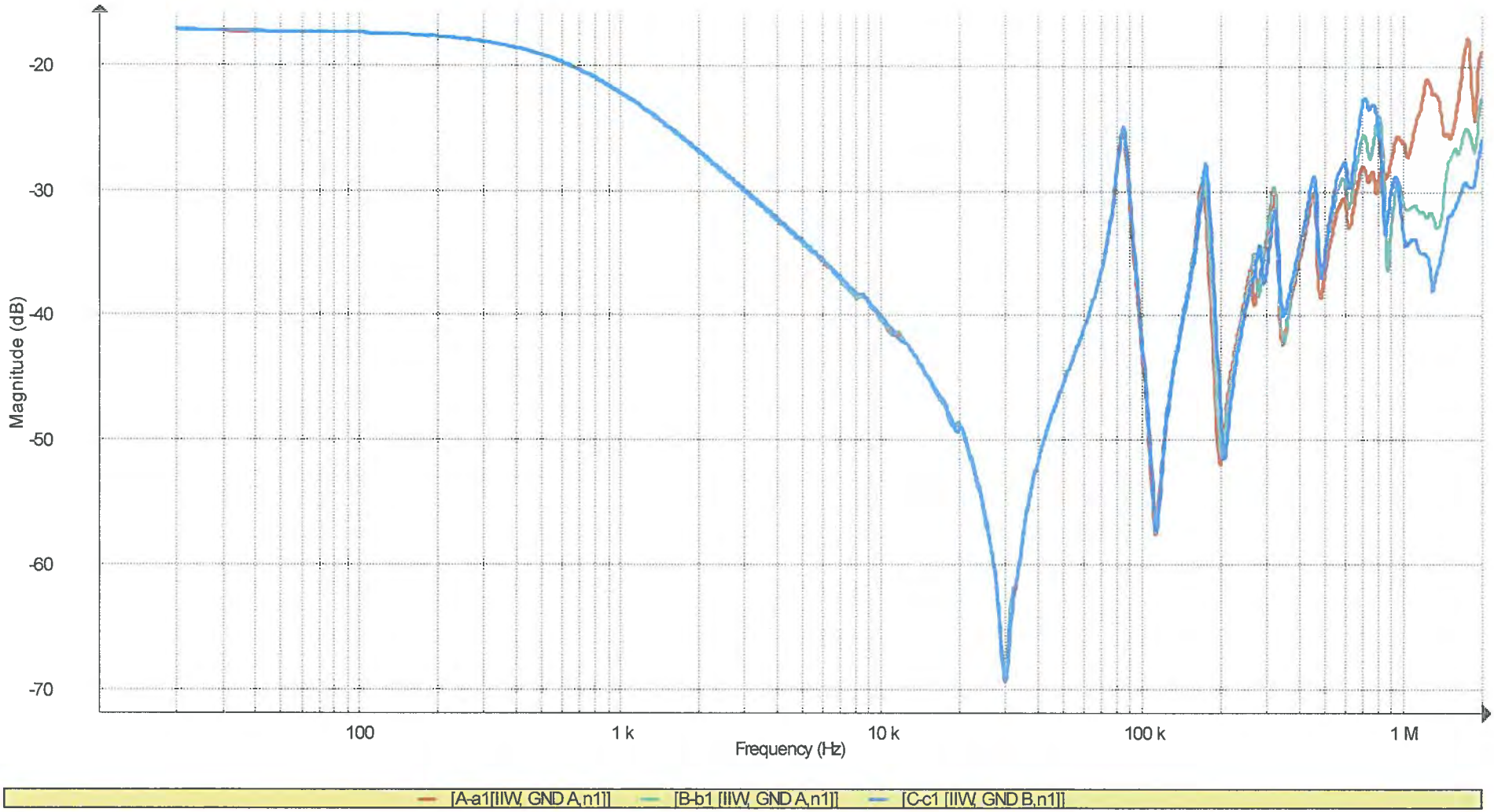


Transformer: "NOTL T1" **at** "NOTL DS"
Serial Number: A 3S-5671
Tested 5/8/2012 **at** 11:40:55

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



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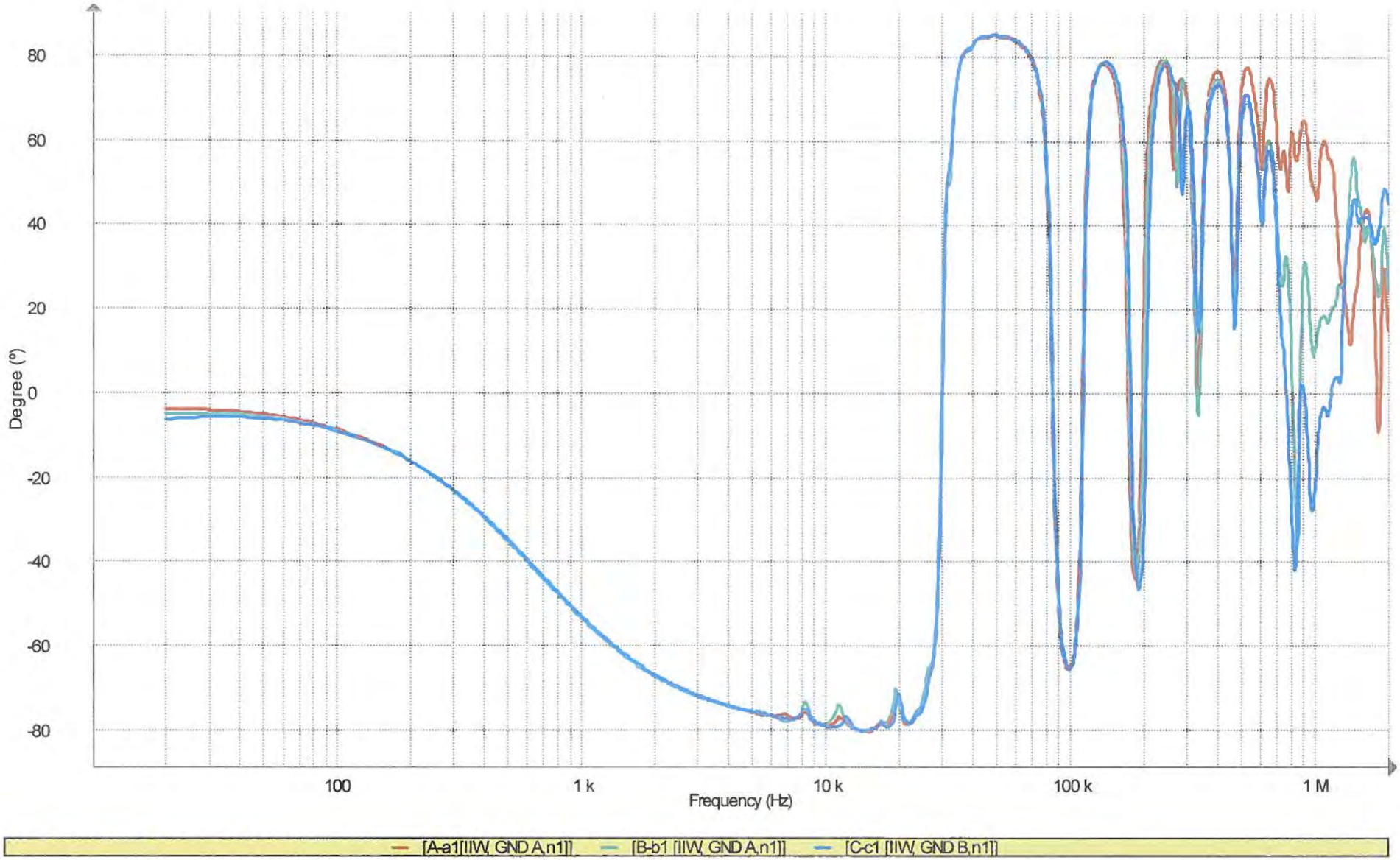


SFRA Test Results

Report date: 2012-06-07

Date of Test: 5/9/2012	**Time of Test:** 08:58:01
Company Name: Ascent	**Location:** NOTL DS
Test Object: NOTL T2	**Manufacturer:** Westinghouse
Serial Number: A 3S-5672	**Built Year:** 1983
Phase Design: 3	**Winding Configuration:**
KV Rating: 15500	**KVA Rating:** 15-20-25
NLTC Position: 3	**LTC Position:** Position 3
Temperature: 13	**Reason For Test:** Assessment Analysis

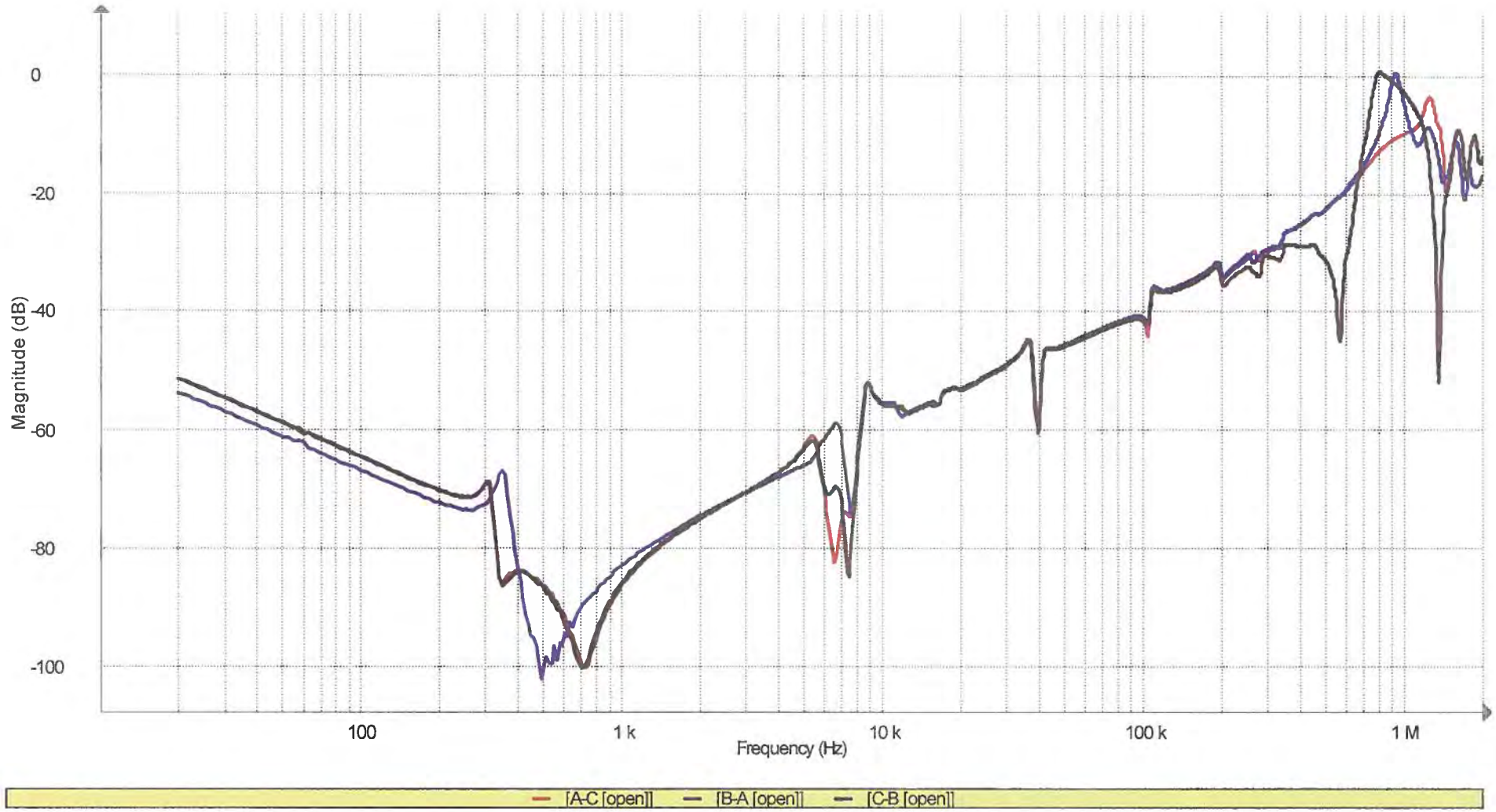
Tested By:
Dave Benjamin

Notes:

Transformer: "NOTL T2" **at** "NOTL DS"
Serial Number: A 3S-5672
Tested 5/9/2012 **at** 08:58:01

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



 Report generated by FRAX software

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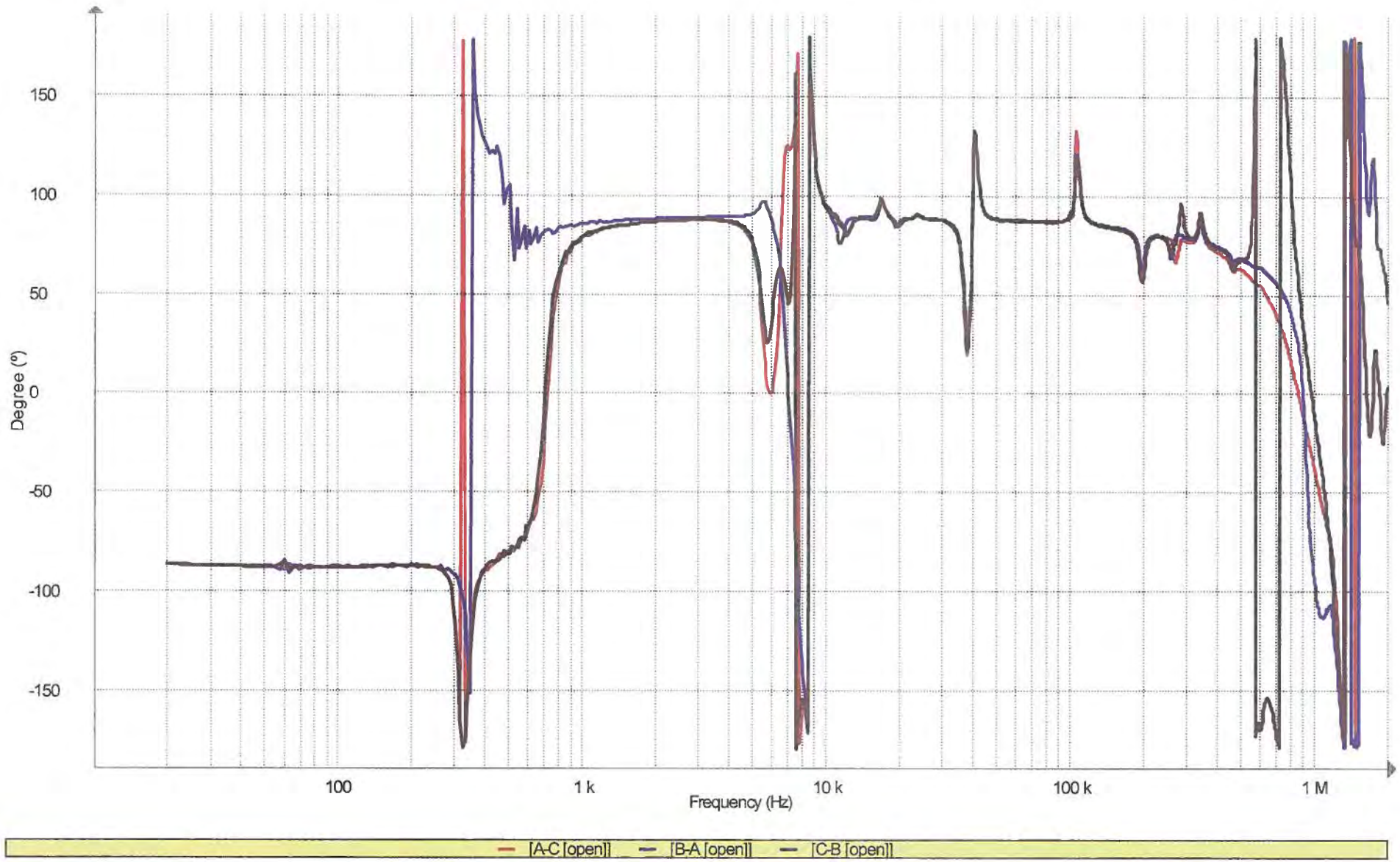
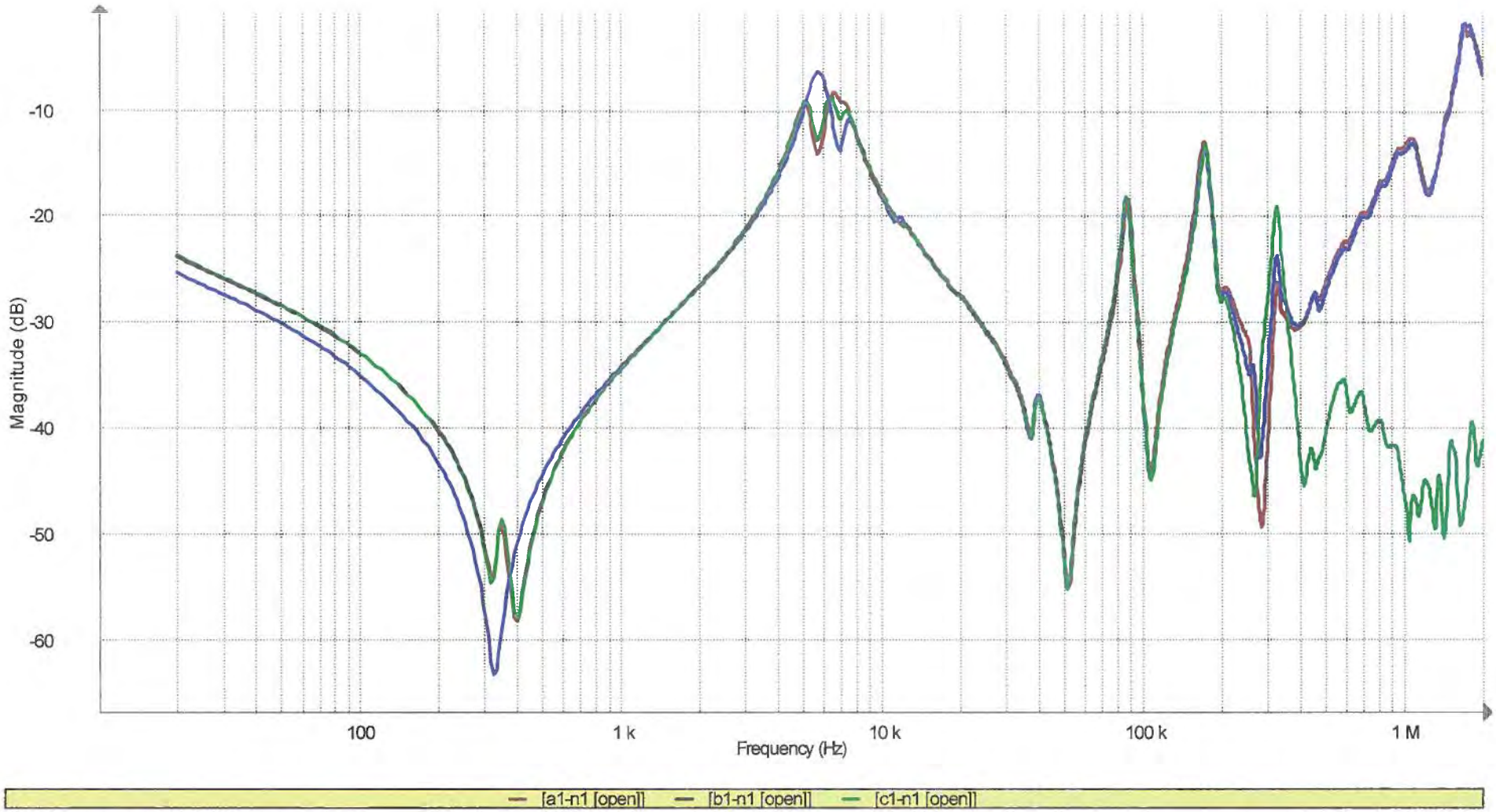


Transformer: "NOTL T2" **at** "NOTL DS"
Serial Number: A 3S-5672
Tested 5/9/2012 **at** 08:58:01

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



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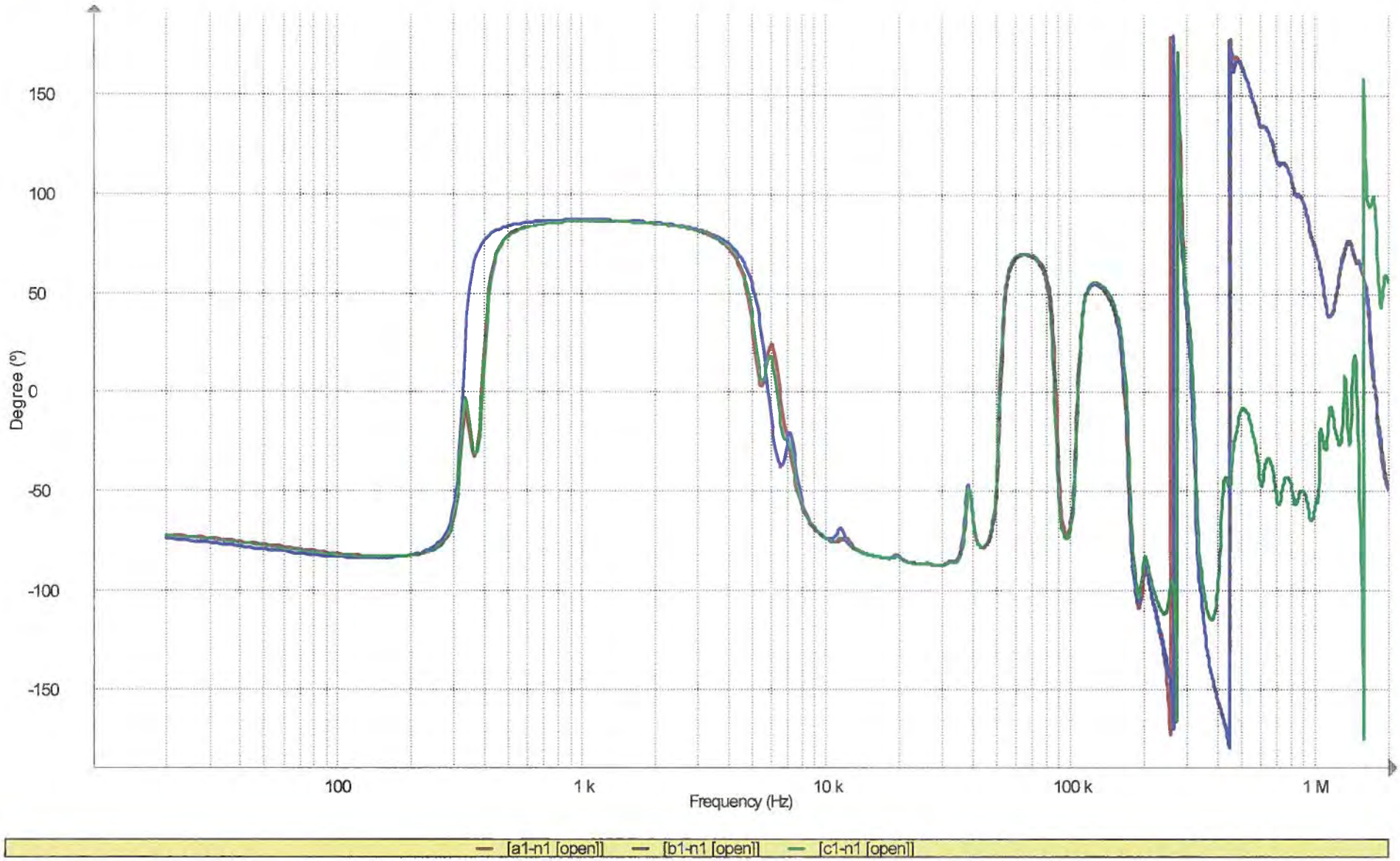
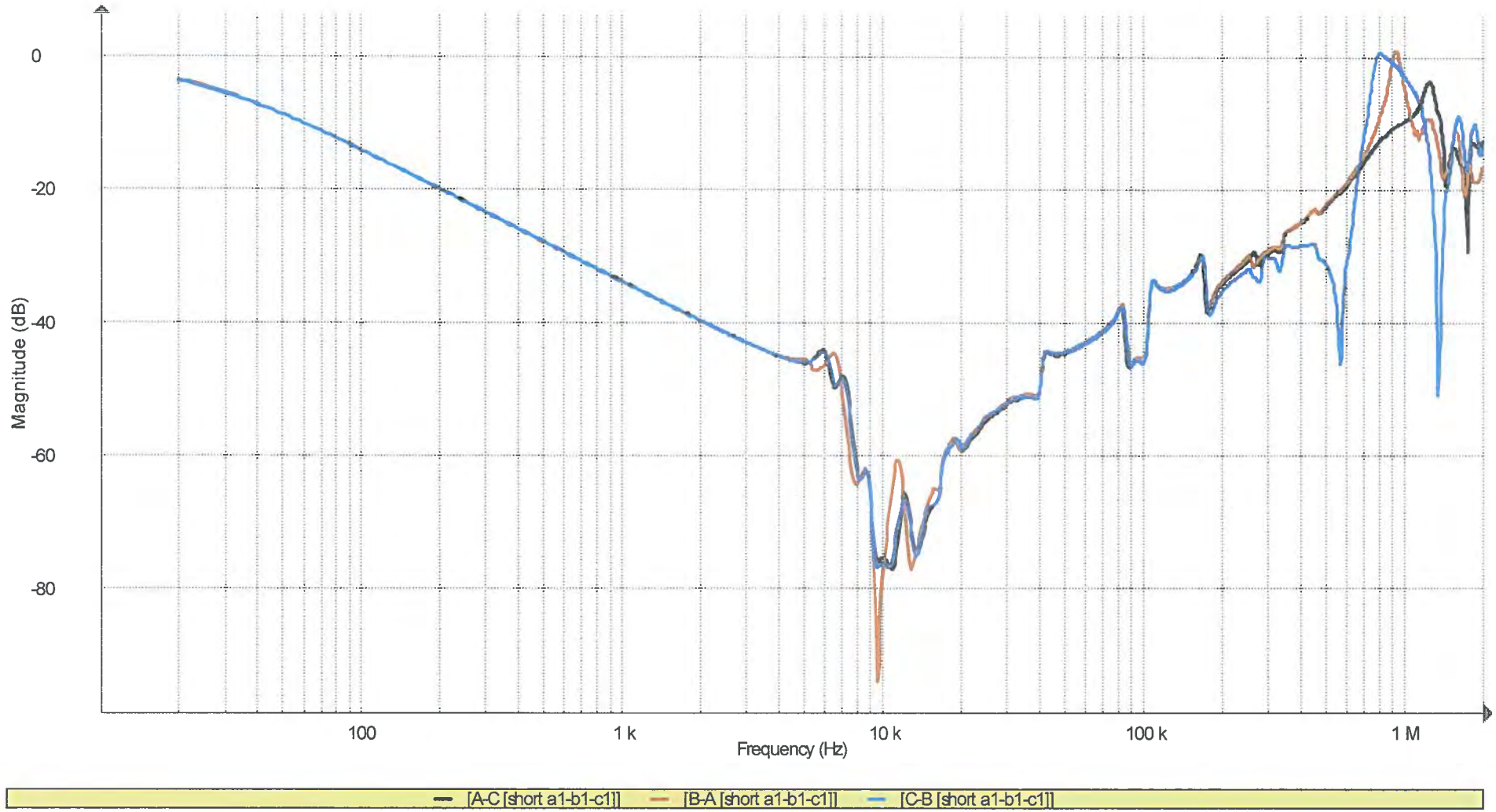


Transformer: "NOTL T2" **at** "NOTL DS"
Serial Number: A 3S-5672
Tested 5/9/2012 **at** 08:58:01

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



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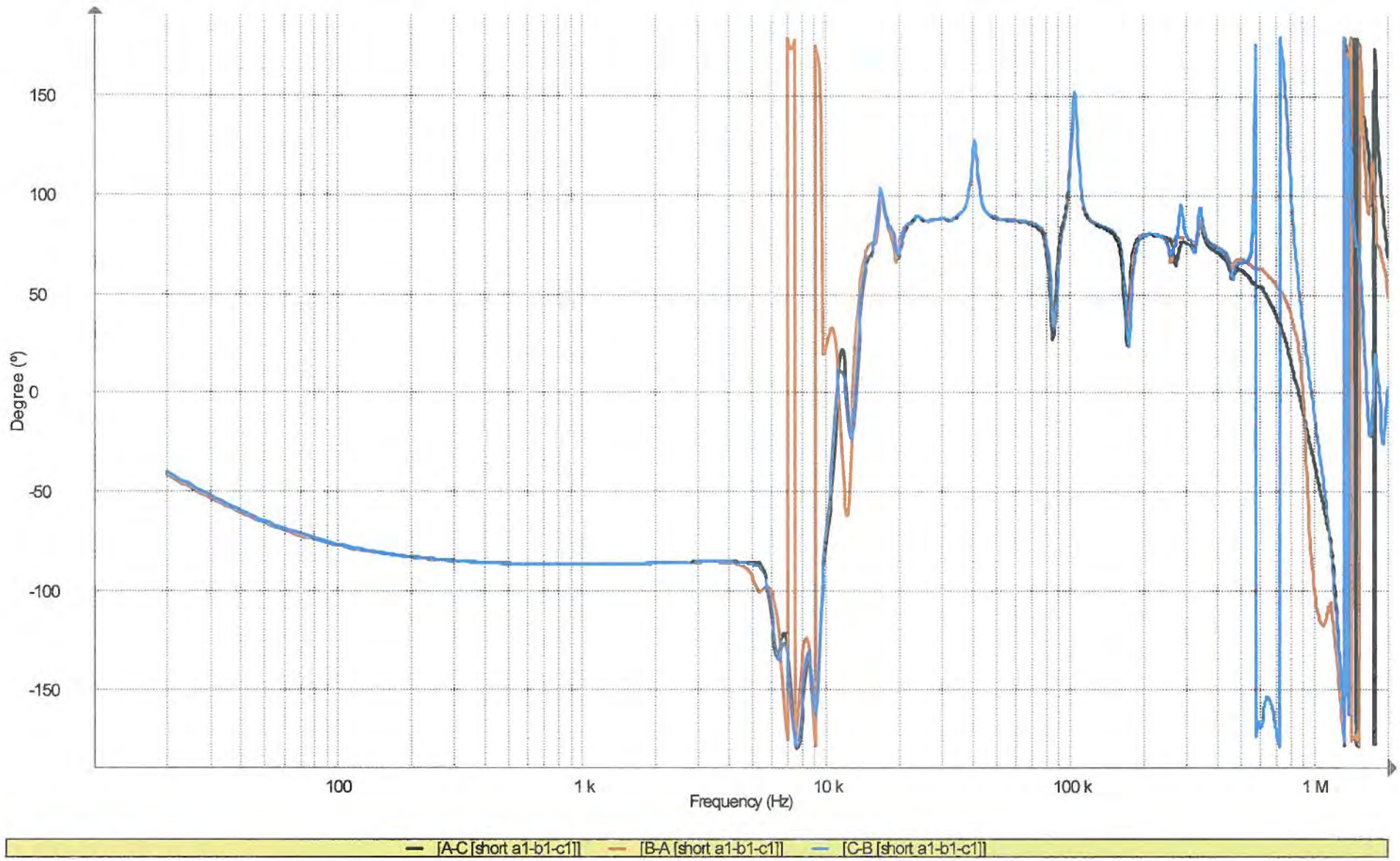
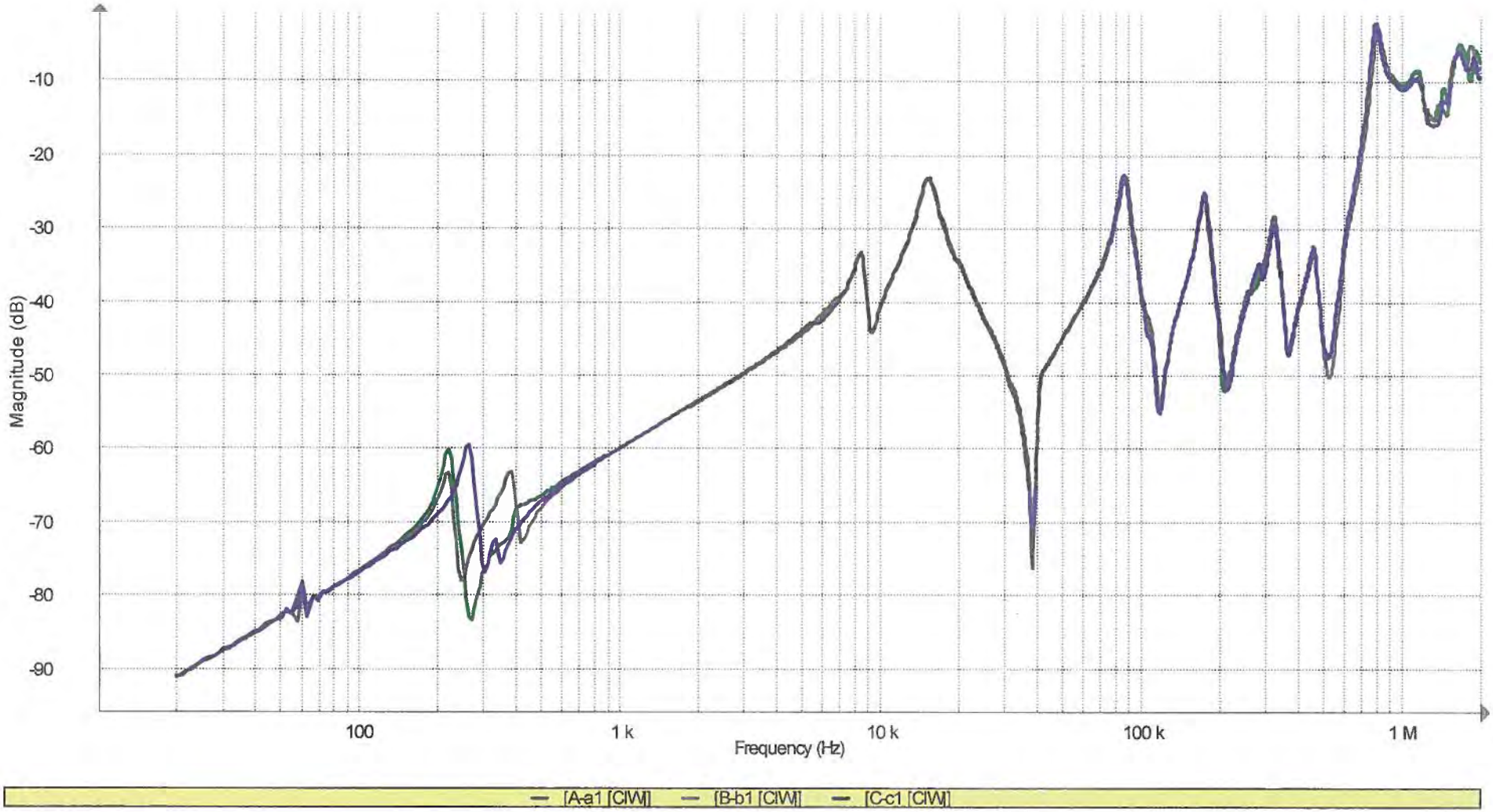
Phase:



Transformer: "NOTL T2" **at** "NOTL DS"
Serial Number: A 3S-5672
Tested 5/9/2012 **at** 08:58:01

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



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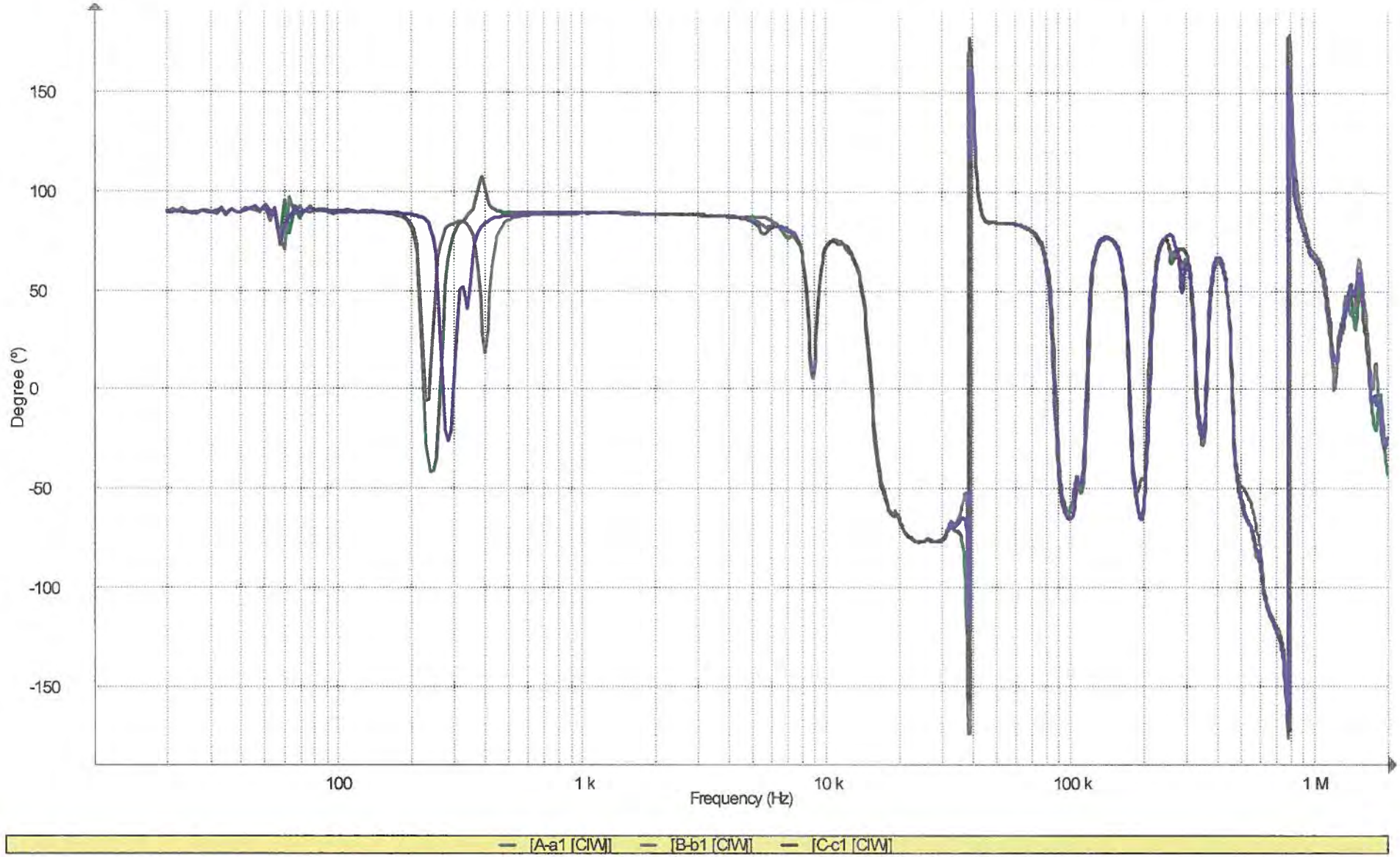
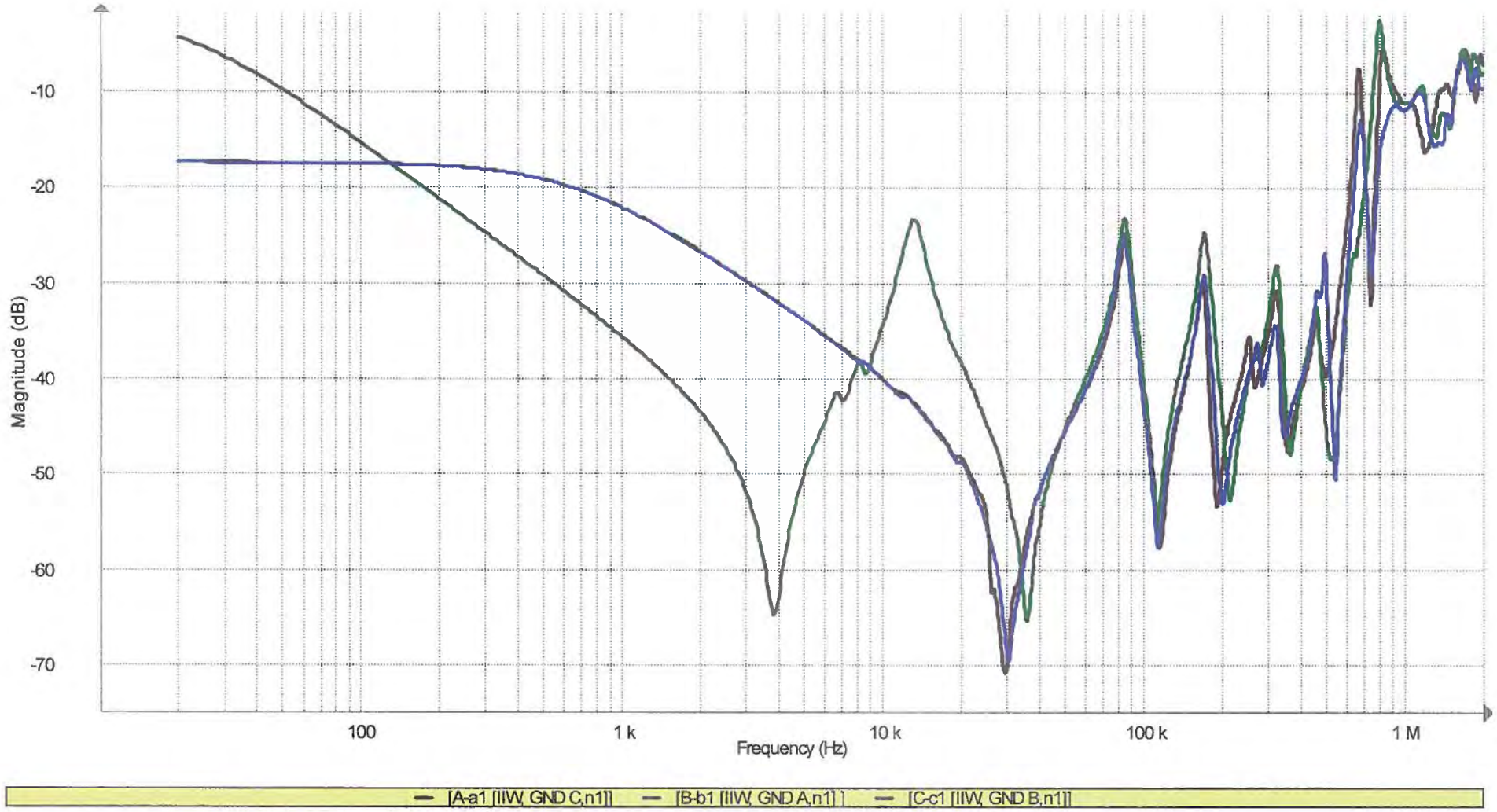


Transformer: "NOTL T2" **at** "NOTL DS"
Serial Number: A 3S-5672
Tested 5/9/2012 **at** 08:58:01

Manufacturer: Westinghouse
Tested by: Dave Benjamin

Magnitude:



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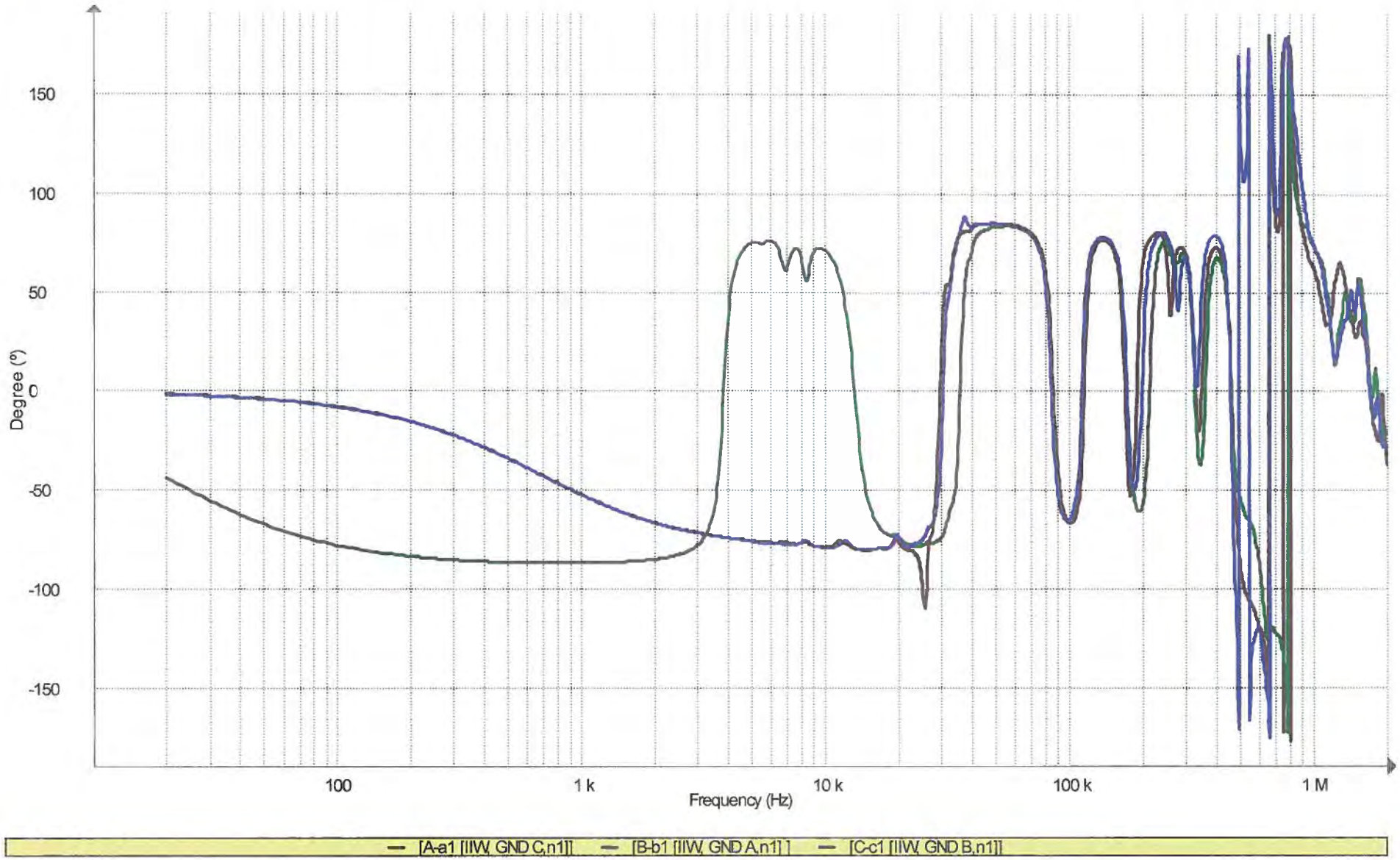

NIAGARA-ON-THE-LAKE HYDRO

DISTRIBUTION SYSTEM PLAN

APPENDIX

F

Long Term Supply Plan

Niagara-on-the-Lake Hydro

Niagara-on-the-Lake, ON

Prepared by

Raven Engineering Inc.

For

Niagara-on-the-Lake Hydro

Rev. 0 – January, 2012

Disclaimer

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Table of Contents

1. Executive Summary

This section to be completed after review.

Andrew Durward, P.Eng.
Raven Engineering Inc.

2. Background

NOTL Hydro dates back to 1972 when the area was taken over from Ontario Hydro. The area load was originally supplied by Niagara Stanley Auto TS at 27.6kV, which had a peak capacity of 20MW. This point of supply has been decommissioned.

In 1985 Hydro One constructed NOTL DS, which has two transformers with a total nameplate capacity of 50 MW.

In 2003 NOTL Hydro constructed York TS, which has a single transformer with a nameplate capacity of 41.7 MW.

Peak loads in 2010/2011 reached 51 MVA. The utility has adequate capacity to meet peak loads with all stations in service, but can no longer meet peak demand with one station alone.

The purpose of this report is to provide a plan to allow the utility to increase the capacity of the stations to supply peak load under contingency, to meet future load growth and to replace aging assets as they reach end of life.

3. Existing Supply

3.1. NOTL DS

NOTL DS is supplied from a single 115kV line Q11S, tapped off the main tower line and continuing approximately 4.5km on wood poles.

The station is equipped with two transformers, rated 15/20/25 MW. The transformers are normally operated in a split bus arrangement, supplying load individually.

There is land owned by the utility outside the station fence to expand the station if required.

There are three feeders, supplied from McGraw Edison Type KVSO reclosers.

Relaying for the station was upgraded in 2009 with the addition of SEL relays. The SCADA RTU is a GE Harris D20 (1996).

There are no known equipment deficiencies at the station.

3.2. York TS

York TS is located adjacent to the Hydro One right-of-way and supplied at 115kV from a line tap to circuit Q12S.

There is a single transformer rated 25/33/41.7 MVA.

There is land available to the west for future expansion of the station.

The station has three feeders at 27.6kV supplied by G&W Viper reclosers.

The relaying for the station is all SEL relays and the SCADA RTU is a GE Harris D25.

There are no known equipment deficiencies at the station.

3.3. Station Capacity

The existing transformers have nameplate ratings that include self cooled and two stages of fans, or ONAN/ONAF/ONAF. The highest ONAF rating assumes all fans are running.

Hydro One uses a transformer rating system to produce a Limited Time Rating, or LTR. The LTR is higher than the nameplate rating, and requires that the transformer was built to the Hydro One specification. This rating permits a certain loss of life to the transformer from overloading for a period of time while relief transformation is obtained. The 10 day LTR rating is used where relief transformation facilities can be put in service within 10 days.

The NOTL DS transformers were built to Hydro One Spec. M-111SM-80 and were loaded within the LTR of 31.8 MVA when owned by Hydro One. Since the utility does not have access to relief transformation facilities within 10 days, this would not be a prudent option for NOTL Hydro and the transformer loading should be limited to its nameplate rating. This provides a station peak capacity of 50 MVA.

The York TS transformer was built to CSA specifications and should be limited to its rating of 41.7 MVA.

The combined station capacity is 91.7 MVA.

3.4. Station Locations

NOTL DS is conveniently located near the centre of the service territory, able to supply load throughout. York TS is located near the southeast corner of the service territory, further from the load centre in the old Town but closer to the anticipated development near the Glendale-QEW interchange.

The 27.6kV distribution voltage allows long feeder lengths and the existing locations do not present a problem.

3.5. Feeder Loading

There are currently six feeders, three supplied from each station. Each feeder is constructed for a 600 amp rating at the station exit.

Due to configuration of the stations, the feeders have the following capacity:

NOTL DS			York TS		
T1		T2	T1		
25 MVA		25 MVA	41.7 MVA		
F1	F2	F4	M1	M2	M3
12.5 MVA	12.5 MVA	25 MVA	13.9 MVA	13.9 MVA	13.9 MVA
261 Amps	261 Amps	522 Amps *	290 Amps	290 Amps	290 Amps

Note that the feeder load assumes balancing the load between feeders.

* The relay settings on the feeders limit loading to 448 Amps.

3.6. Reliability of Supply

Both NOTL Hydro stations are supplied from a single 115kV line and operated as a single transformer supplying load. At NOTL DS there are two transformers side by side operating independently. This system is typical for rural supply areas in Ontario. There is no redundancy in the supply and should the station experience a catastrophic failure customers will be without power. Fortunately, such total station failures are rare.

The two stations are supplied from different 115kV Hydro One owned transmission lines on common towers. NOTL DS is supplied from Q11S and York TS from Q12S. A 115kV circuit outage would only affect one station.

The 115kV lines can be supplied from either end and line switches exist to isolate the line sections on either side of the station tap. A line failure on one of the 115kV lines could be isolated by switching, and service to the NOTL station restored from the healthy section. This provides good reliability of the 115kV supply.

A failure on the 4.5km wood pole 115kV line from the Q11S line tap to NOTL DS would interrupt supply until the pole line could be repaired.

The worst case failure for customer supply would be a transformer outage. Currently, a transformer outage at York TS would interrupt all load supplied from the station. A long term outage would require transferring all load from York TS to NOTL DS. Adequate 27.6kV feeders exist for such a transfer, and it is routinely done for maintenance in the off peak season.

A transformer failure at NOTL DS would have less impact since there are two transformers. Load could be transferred to the second transformer and to York TS.

3.7. Remaining Life of Substation Transformers

The planning and financial lifespan of a substation transformer is commonly quoted as 40 years, and many units have had service lives of up to 60+ years. Long service life requires construction to an accepted standard, routine maintenance throughout the life of the asset, and avoiding the life shortening effects of loading beyond the rating.

The NOTL DS transformers meet the first two criteria but it is known that the station was operated at or above capacity prior to York TS being constructed. When the station was operated by Hydro One they used a 10 day LTR criteria for loading, which assumes an acceptable loss of service life to the transformer from overloading. There is no quantitative data on how much service life was impacted.

The NOTL transformers were constructed in 1983, making them 29 years old in 2012. It is a suitable time to assess the remaining age of the transformers, and to consider remedial work as required to maintain the asset.

The York transformer was constructed in 2003 and the transformer is less than 10 years old.

4. System Load

4.1. Historic Load

Load data dating from 1971 has been supplied by the utility and is shown in graphical form in Figure 1. Peak load reached 50.7 MVA in 2011.

4.2. Load Growth

Peak load for the utility is expected to grow slowly over time, with residential and development both occurring on a smaller scale. The addition of FIT and micro-FIT generation has the effect of offsetting load, and future economic growth in the area is anticipated to be slow.

No load growth study was done for this report. Instead, the recommended approach is to phase in station capacity expansion as load growth occurs and transformer assets reach end of life.

Figure 2 shows the supply station capacity plotted with the peak load. For illustrative purposes, a load growth of 1% has been shown beyond 2011.

4.3. Renewable Generation

A considerable number of renewable generators have been added to the NOTL distribution system in the past several years. From larger projects such as Weir 3 GS at 2.2 MW down to FIT and MicroFit projects, the total amount is currently 3.3MW. This generation supplies utility load and offsets the station loading.

Weir 3 GS is hydro-electric and production is intermittent depending on Welland Canal water levels and flows. The remainder is predominantly solar photovoltaic, the majority of which can be expected to be producing on a sunny summer day when peak load occurs. Peak load typically occurs between 4 and 6pm, while solar production peaks at midday when the sun is highest.

While renewable generation improves supply capacity, it is non-dispatchable, intermittent and provides a small component (6.5%) of peak utility load. For planning purposes renewable generation cannot be relied upon for full capacity during peak load periods.

5. Existing Supply Capability

With both stations in service, the peak load can be easily supplied. However, with one station out of service, the utility will be unable to meet peak load. Rotational load shedding will be required to protect the remaining transformer(s) from damage due to overloading.

The risk of operating in this manner depends on the risk of a foreseeable event causing the loss of an entire station. This could occur for various foreseeable events including:

- Loss of 115kV supply from Hydro One
- Transformer failure at York TS
- Failure of the 4.5km wood pole line supplying NOTL DS

As load growth occurs, the impact of such an event increases.

6. Planning Requirements

The study identified the following planning requirements to be considered.

- Increase station capacity at York TS and NOTL DS to permit each station to supply peak utility load. This will avoid rotational load shedding in the event of a station loss during peak load periods (summer).
- Assess the remaining life of the NOTL DS transformers.
- Ensure that available station capacity can be utilized.

7. Options to Increase Station Capacity

There are several options available to the utility to increase supply capacity. These are discussed in this section.

7.1. Option 1 - Upgrade to DESN

For urban supply areas, a more common station configuration is a DESN station, or Dual Element Spot Network. Such a station is supplied by two incoming high voltage lines, has two identical transformers normally operated in parallel supplying two low voltage buses. Any of these components can fail without seriously affecting supply reliability, as the companion equipment is capable of carrying the total station load.

A DESN station provides better reliability but requires redundant equipment and more facilities than the existing NOTL stations. Converting one or both of the NOTL stations would require:

- A second 115kV line tap from Hydro One,
- A second 115kV circuit switcher,
- A second transformer, same size and characteristics as the existing,
- A second low voltage bus, and a bus tie breaker,
- Additional protections including bus differential, breaker failure and high voltage line protections including telecommunications equipment to interface with Hydro One for transfer tripping.
- A DESN station would have higher short circuit levels than the existing station, requiring the existing feeder reclosers to be replaced with circuit breakers.

While this would provide the highest reliability solution, the level of cost involved makes it prohibitive.

7.2. Option 2 - Replace Transformers

The existing station transformers can be replaced with larger units.

This is a feasible option for NOTL DS. The existing transformers are 29 years old and could be either refurbished and sold, or sold as is to help offset the cost of two new larger transformers. However, the transformers have significant life left in them and the utility should utilize these assets if possible. This option is better suited to a very large utility that can use the transformers at another substation location.

This option is not suitable for York TS since the existing transformer is less than 10 years old.

7.3. Option 3 - Construct a New Supply Station

Due to the low level of anticipated load growth and the cost involved, this alternative was not considered. The two existing sites provide redundancy and can be expanded to supply future load growth.

7.4. Option 4 - Add Static Capacitors to Existing Stations

A small increase in substation capacity can be gained by the addition of static capacitors. The capacitor bank corrects the power factor of the transformer loading, freeing up capacity currently used by the reactive power component.

The power factor at the existing stations is quite good. NOTL DS average power factor is above 96% and York is 94%. Adding capacitors would provide a minimal gain in capacity. It would defer a capacity increase but not eliminate it.

7.5. Option 4 - Add a Fourth Substation Transformer

This option involves replacing the existing 15/20/25 MVA NOTL T1 with a new 25/33/41.7 MVA transformer similar to York T1. This would bring the NOTL DS capability up to 66.7 MVA which would allow it to supply the utility peak load.

The existing NOTL T1 would be relocated to the York site and installed as York T2, also bringing the station capacity up to 66.7 MVA. Both stations would be similarly equipped with one 25 MVA newer transformer and one 15 MVA older transformer.

Based on the 2% load growth assumption, this would permit either station to supply peak utility load until beyond 2023 when the 15 MVA units would be 40 years old. Based on their condition and the load at that time, a decision would be made to either extend their service life beyond 40 years or replace them.

The ultimate development stage would be to have companion 25 MVA transformers at both sites, giving both stations a capacity of 83.4 MVA.

7.6. Option 6 - Do Nothing

Under this alternative, the utility would continue to be exposed to the risk of rotating blackouts in the event of a total station outage during peak load periods.

This option is not considered viable.

8. Recommendation

The most economical option to provide station capacity to meet utility peak load under contingency conditions is Option 4 – Add a Fourth Substation Transformer.

This option provides:

- two stations of similar configuration and capacity,
- each supplied from separate 115kV sources,
- each capable of supplying utility peak load for the foreseeable future,
- makes good use of existing assets,
- minimizes expenditure on new assets,
- provides for planned or forced outages, allowing elements to be taken out of service one at a time, similar to the benefits of a DESN station.

As a good balance between reliability of supply and cost, this is the recommended option.

9. Implementation

9.1. Upgrade NOTL T1

The following major items need to be considered to increase NOTL T1 to 25 MVA.

9.1.1. Transformer Foundation

The existing concrete transformer pad at NOTL DS is rated for a maximum transformer weight of 59,000 kg.

For reference, the York T1 transformer has a total weight of 69,925 kg.

Transformer foundation reinforcement or replacement will be required to upgrade NOTL T1.

9.1.2. Oil Containment

The oil containment at NOTL DS has a volume of 21.0m3 within the concrete curbs and above the stone. The existing transformers contain 20473 litres of oil in the transformer and plus an additional __ litres in the tapchanger.

For reference, the York T1 transformer has an oil capacity of 30582 litres, including the tapchanger.

Oil containment expansion will be required to upgrade NOTL T1.

9.1.3. Ground Grid

A review of the station ground grid resistance is recommended before increasing transformer size. Good records of the existing grid exist.

9.1.4. HV Capacity

The 115kV supply line is owned by Hydro One. The ability of this line to supply additional transformation will be determined during their assessment of the expansion.

The 115kV bus in the station is rated at ___.

The 115kV circuit switchers are rated at 1200 amps.

The existing peak 115kV load of the station (50 MVA) is 251 amps. This will increase to 335 amps with the upgrade of T1 to 25 MVA and to 419 amps with the future upgrade of T2 to 25 MVA.

The HV bus and circuit switchers can supply the increased transformer size. A review of the drop leads and connections is required to confirm sufficient rating.

9.1.5. LV Capacity

The 27.6kV bus and switches are all rated at 1200 amps.

Full load of a 25/33/41.7 MVA transformer is 872 amps.

The LV bus and switches can supply the increased transformer size.

9.1.6. Short Circuit Levels

Increasing the transformer size can result in an increase in short circuit levels. The impedance of the transformer will influence the actual short circuit levels.

Existing 3ph bus short circuit level at NOTL DS is 3058 Amps (146 MVA).

Preliminary calculations show an increase to 4299 Amps (206 MVA) if T1 was replaced with a transformer similar to York T1. A detailed short circuit study would be required with actual transformer parameters.

The interrupting rating of the feeder reclosers is 12.0 kA.

The short circuit withstand of the LV bus would need to be verified.

The feeder relay settings would need to be checked against the new short circuit levels.

9.1.7. Protection and Control

New main and backup transformer protections were installed in 2009, along with HV circuit switchers. The protections are suitable for a larger transformer and will require a change in relay settings. Re-use or replacement of existing CT and control cables will be determined at the design stage.

The existing SCADA RTU has some spare capacity and the ability for expansion if required. Most of the SCADA points from the existing T1 would be re-used.

9.1.8. Metering

The station is currently metered at the LV level near the secondary of the transformers. A review of the metering current transformers is required to determine if they have capacity to meter the larger transformer.

9.1.9. Feeder Egress

NOTL T1 supplied two feeder positions. Assuming balanced load between feeders, the new transformer would provide feeder capacity of 436 amps per feeder. This is within the equipment ratings and below 80% of the relay pickup settings. The existing F1 and F2 can handle the increased transformer size.

NOTL T2 can supply more load than the existing feeder can take out of the station. The limiting factor is the 80% relay pickup criteria, limiting feeder loading to 448 amps or 21.4 MVA. This can be addressed by effectively shortening the feeder by adding a line recloser, permitting an increase in the feeder relay settings.

Another option to utilize the full capacity of T2 would be to add a fourth feeder position. The station was constructed with provision for four feeders. There is a position available for a fourth feeder breaker, including bus space, bus support foundation, control duct and primary ducts exiting the station. There is sufficient capability for egress from the station for a fourth feeder on Conc. 5.

The ultimate configuration for NOTL DS would be two 25/33/41.7 MVA transformers, at which point the fourth feeder position would be required.

9.1.10. Parallel Operation of Transformers

There may be times when the transformers will be paralleled, for example when transferring load without causing a customer outage. Due to the difference in impedances, the existing NOTL DS transformers and York TS transformer would share load in approximate relation to their ratings assuming equal voltages.

If the new NOTL T1 has a similar impedance to York T1 (9.95%) then parallel operation during switching will not present a problem.

The normal operation will continue to be split bus, with each transformer supplying load independently.

9.2. NOTL Transformer Assessment

This plan option assumes that the existing NOTL transformers are suitable for continued use in the long term. Routine gas-in-oil and oil analysis and electrical tests do not show any significant problems with the transformers. Their condition should be verified by undertaking a thorough condition assessment.

An initial assessment can be done in situ prior to replacement and will require taking the transformers out of service one at a time.

The results of the assessment will determine if remediation is required and a plan for such will be determined at that time. The transformers may require transport to a repair facility or may only require work on site. Once a new larger NOTL T1 is in service, sufficient capacity will be available to remove the smaller transformers for repair and relocation.

There are a number of large transformer service providers available to undertake the assessment and/or repair.

9.3. York T2

The preferred option includes upgrading the capacity of York TS by relocating the old NOTL T1 to the York site as T2.

At present, York has no facility at all for a second transformer, so a station expansion will be required. The station expansion should consider the ultimate stage of two 25/33/41.7 MVA transformers and include provision for the eventual replacement of York T2 with a larger unit.

The expansion of York TS will include:

- Detailed design,
- Hydro One and IESO approvals,
- Land acquisition to the west,
- Site grading, draining, grounding and fencing,
- Transformer, switch and bus foundations,
- Procurement and construction,
- Relaying and SCADA upgrades,
- At least one new feeder position, preferably two and provision for three.
- New feeder exits and egress.

York TS currently has no spare breakers. There is a spare set of ducts exiting the station, but one of them was recently used to bring an alternate station service supply in from York Rd. Any additional feeders will require bus extension and new foundations.

9.4. Budget

This section to be developed.

9.5. Timeline

The following timeline is intended to be illustrative. At present there are no specific schedule constraints.

- Q1 2012 Supply Plan Report presented to the Board
- Q2 2012 NOTL T1/T2 transformer assessment
- Q3 2012 Design work for NOTL T1 replacement (budget?)
- Q4 2012 Submit proposal to Hydro One / IESO
- Q1 2013 Hydro One / IESO Approval
- Q1 2013 Order New NOTL T1
- Q2 2013 Expand York TS
- Q1 2014 Replace NOTL T1
- Q2 2014 Refurbish old NOTL T1
- Q3 2014 Install York T2
- Q4 2014 Refurbish NOTL T2

10. Attachments

Figure 1	NOTL Hydro Peak Load
Figure 2	NOTL Hydro Peak Load vs. Station Capacity
Figure 3	NOTL Hydro Peak Load vs. Proposed Station Capacity
Drawing E1	Supply Stations Existing
Drawing E2	Supply Stations Expansion – Phase 1 – NOTL T1 Upgrade
Drawing E3	Supply Stations Expansion – Phase 2 – York T2

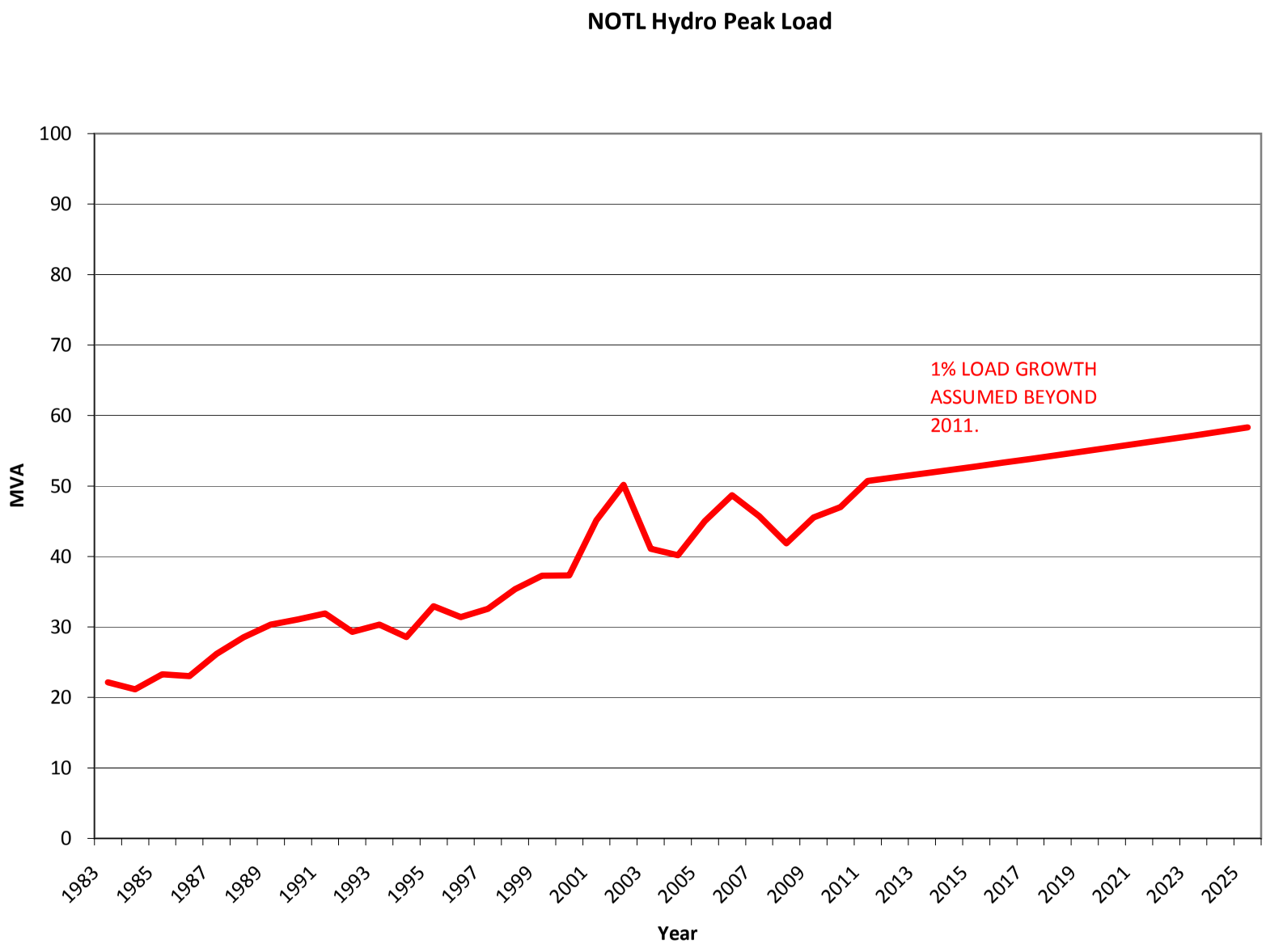

NOTL Hydro Peak Load
MVA
100
90
80
70
60
50
40
30
20
10
0
1% LOAD GROWTH
ASSUMED BEYOND
2011.
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
2025
Year

Figure 1

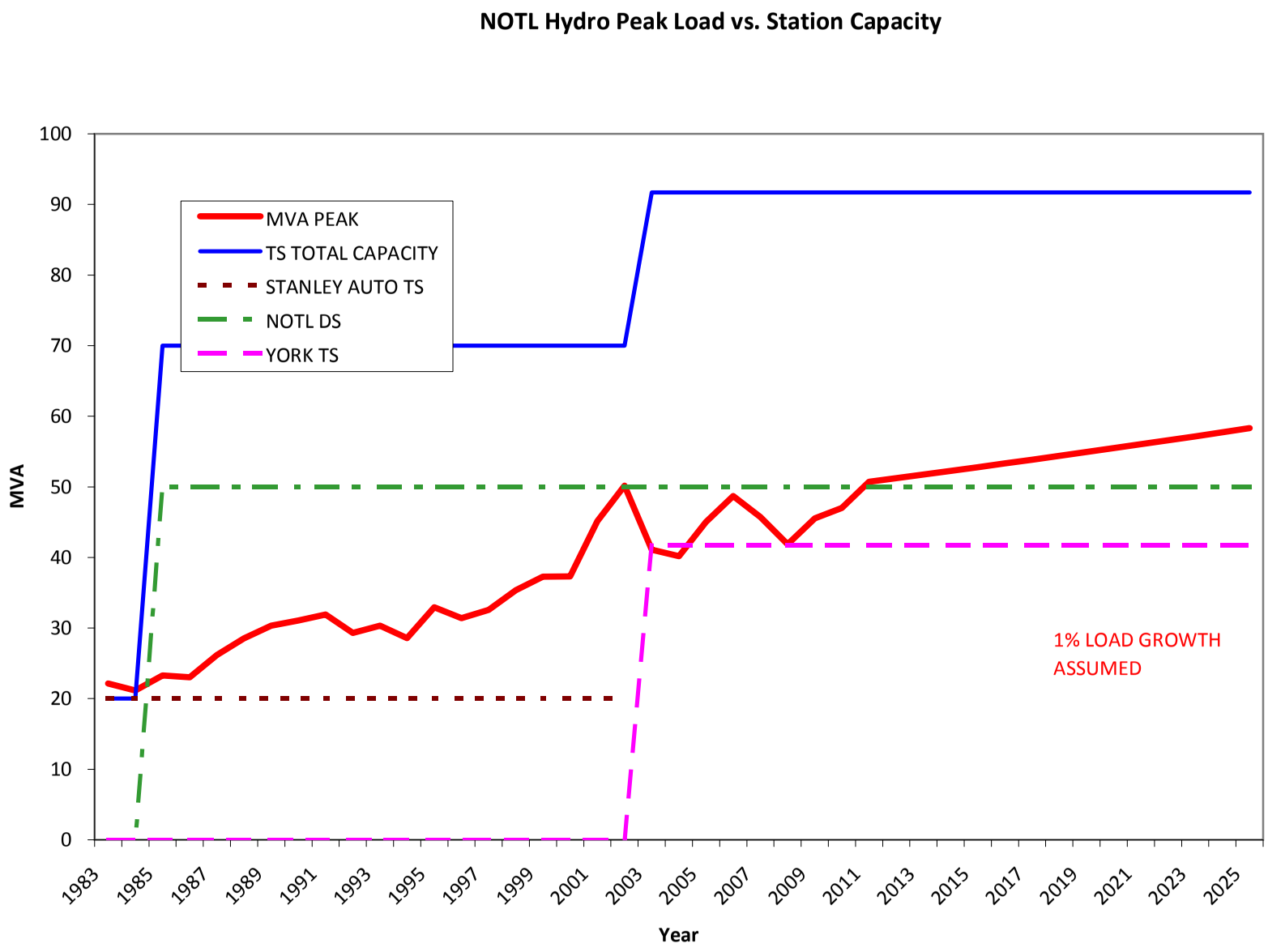

NOTL Hydro Peak Load vs. Station Capacity
MVA PEAK
TS TOTAL CAPACITY
STANLEY AUTO TS
NOTL DS
YORK TS
1% LOAD GROWTH ASSUMED
MVA
Year
0
10
20
30
40
50
60
70
80
90
100
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
2025

Figure 2

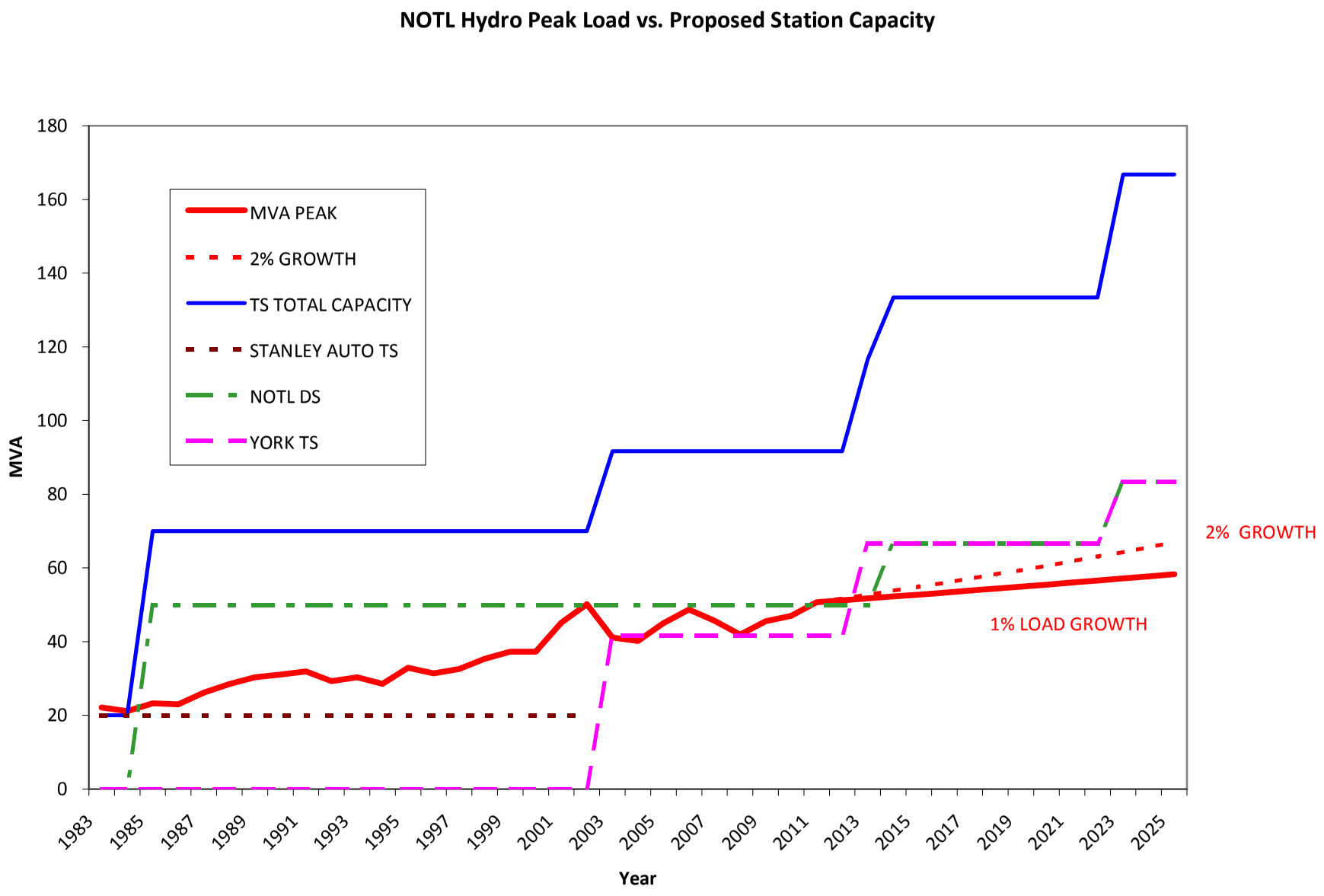
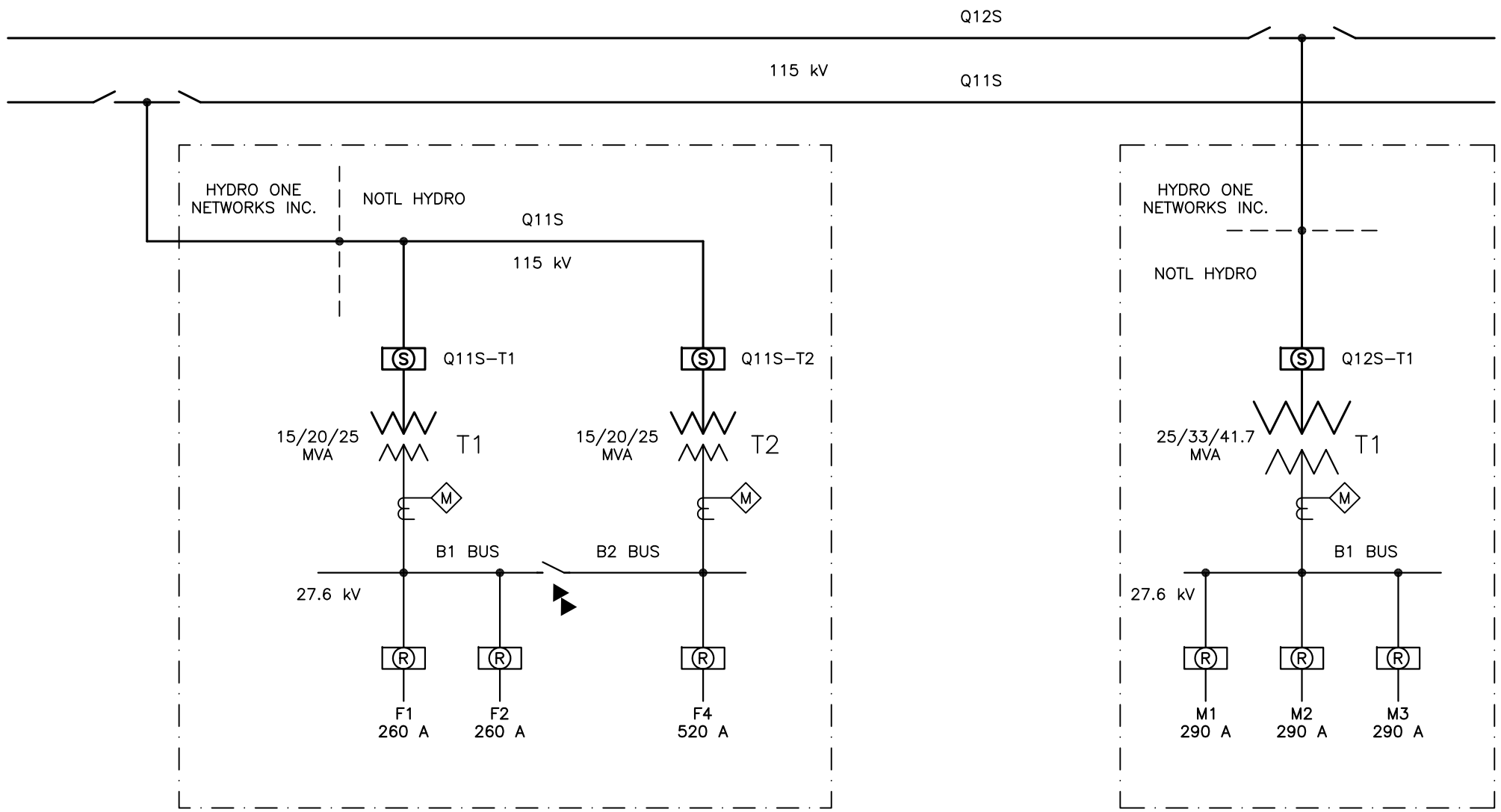

NOTL Hydro Peak Load vs. Proposed Station Capacity
MVA
Year
MVA PEAK
2% GROWTH
TS TOTAL CAPACITY
STANLEY AUTO TS
NOTL DS
YORK TS
2% GROWTH
1% LOAD GROWTH
0
20
40
60
80
100
120
140
160
180
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
2023
2025

Figure 3

NOTES

1. THIS SCHEMATIC IS FOR ILLUSTRATIVE PURPOSED ONLY.
   NOT ALL FACILITIES ARE SHOWN.



NOTL DS

50.0 MVA CAPACITY

27 ? MVA PEAK LOAD

YORK TS

41.7 MVA CAPACITY

13 ? MVA PEAK

RAVEN
Engineering Inc.
Niagara Falls, ON.
(905) 353-9252

LEGEND

- GANG OPERATED LOADBREAK SWITCH
- DISCONNECT SWITCH
- CIRCUIT BREAKER
- CIRCUIT SWITCHER
- RECLOSER
- FUSE
- REVENUE METERING

E1

#	REVISIONS	DATE
A	FOR REVIEW	1/27/2012

NIAGARA–ON–THE–LAKE HYDRO

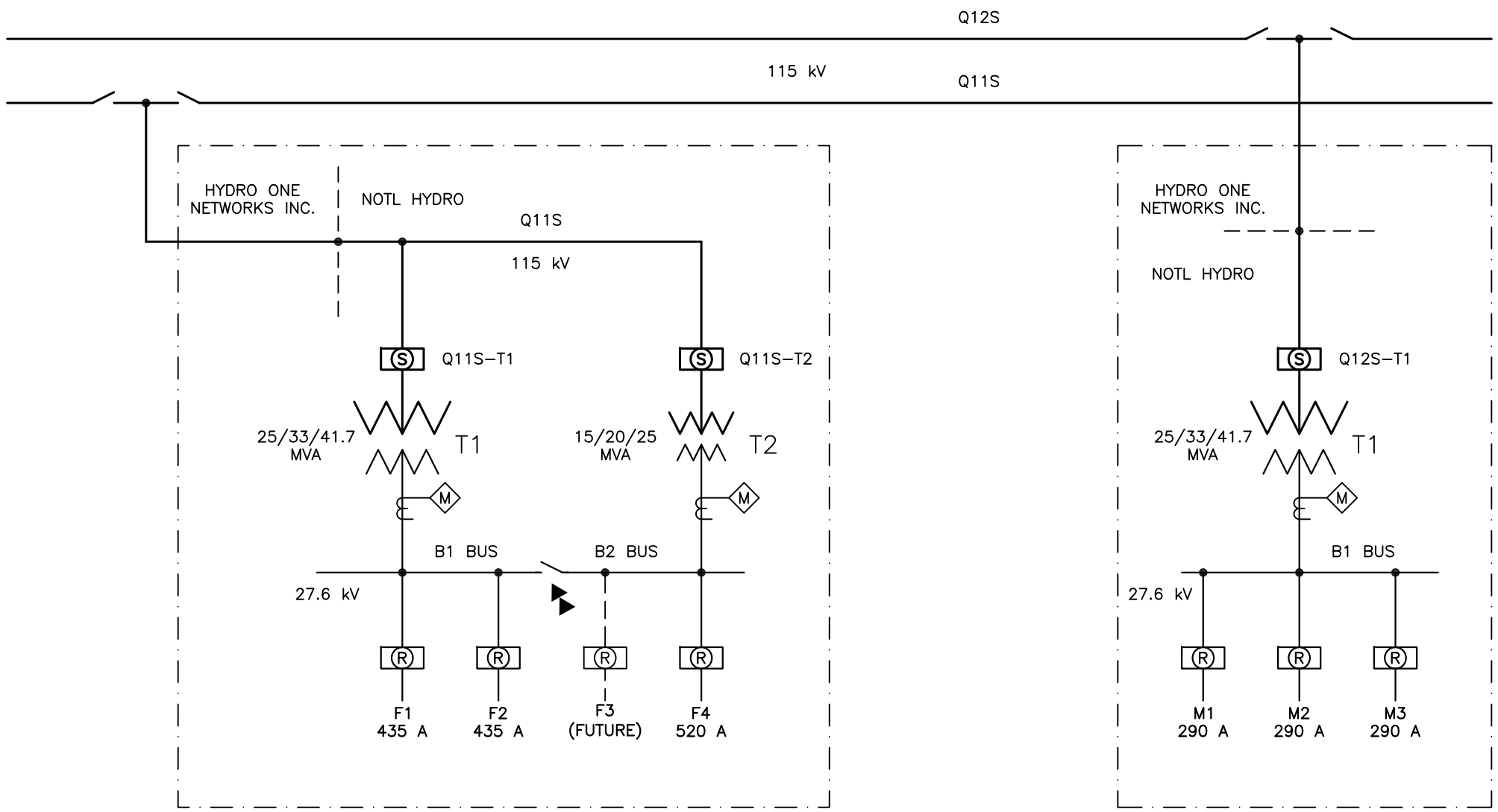
SUPPLY STATIONS

EXISTING

dwn LH	designed by	cad use	
chkd AD			
date month/day/yr 1/6/2012	design approved ———		plot scale
			dist. code
scale Not To Scale	authorized		electronic filename 110229–E1 RA.DWG
w.o.			
dwg no 110229–E1			rev A

PHASE 1

1. REPLACE NOTL T1 WITH 25/33/41.7 MVA TRANSFORMER SIMILAR TO YORK T1.
2. RE–USE EXISTING CIRCUIT SWITCHER Q11S–T1 AND EXISTING T1 PROTECTIONS.
3. REQUIRES REVIEW OF SHORT CIRCUIT LEVELS, GROUND GRID, GPR AND FEEDER PROTECTION SETTINGS.



NOTL DS

66.7 MVA CAPACITY

YORK TS

41.7 MVA

RAVEN
Engineering Inc.
Niagara Falls, ON.
(905) 353-9252

LEGEND

- GANG OPERATED LOADBREAK SWITCH
- DISCONNECT SWITCH
- CIRCUIT BREAKER
- CIRCUIT SWITCHER
- RECLOSER
- FUSE
- REVENUE METERING

E2

#	REVISIONS	DATE
A	FOR REVIEW	1/27/2012

NIAGARA–ON–THE–LAKE HYDRO

SUPPLY STATIONS
EXPANSION – PHASE 1
NOTL DS T1 UPGRADE TO
25/33/41.7 MVA

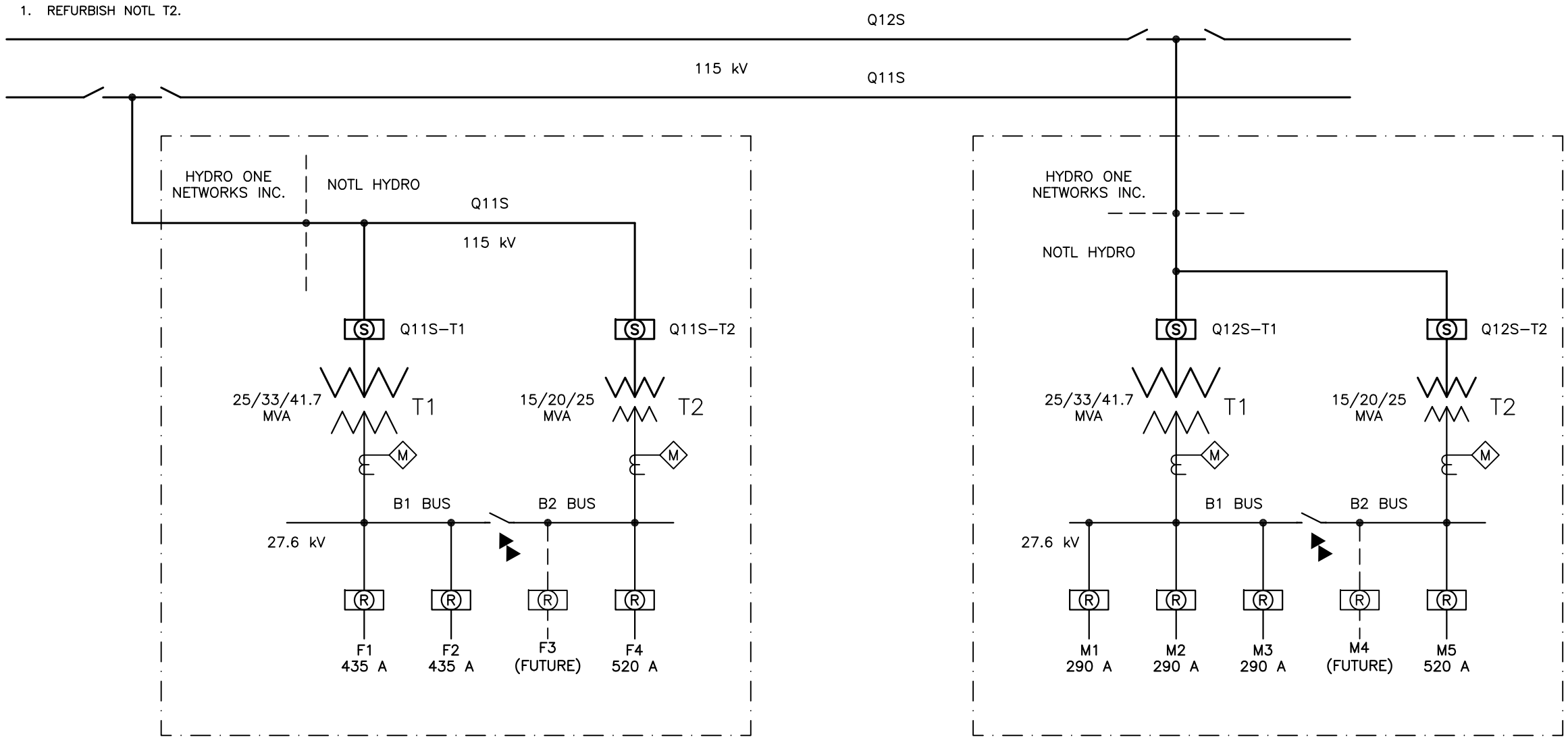
dwn LH	designed by	cod use	
chkd AD			
date month/day/yr 1/6/2012	design approved ———		plot scale
			dist. code
scale Not To Scale	authorized		electronic filename 110229–E2 RA.DWG
w.o.			
dwg no 110229–E2			rev A

PHASE 2

1. REFURBISH OLD NOTL T1 AND INSTALL AS YORK T2.
2. NEW CIRCUIT SWITCHER Q12S–T2 AND T2 PROTECTION.
3. NEW T2 FOUNDATION, GROUND GRID EXPANSION, STATION FENCE EXPANSION, MODIFIED 115KV BUSWORK.
4. REQUIRES REVIEW OF SHORT CIRCUIT LEVELS, GROUND GRID, GPR AND FEEDER PROTECTION SETTINGS.

PHASE 3

1. REFURBISH NOTL T2.



NOTL DS

66.7 MVA CAPACITY

YORK TS

66.7 MVA CAPACITY

RAVEN
Engineering Inc.
Niagara Falls, ON.
(905) 353-9252

LEGEND

- GANG OPERATED LOADBREAK SWITCH
- DISCONNECT SWITCH
- CIRCUIT BREAKER
- CIRCUIT SWITCHER
- RECLOSER
- FUSE
- REVENUE METERING

E3

#	REVISIONS	DATE
A	FOR REVIEW	1/27/2012

NIAGARA–ON–THE–LAKE HYDRO

SUPPLY STATIONS
EXPANSION – PHASE 2
NEW YORK T2
REFURBISHED 15/20/25 MVA

dwn LH	designed by	cad use	
chkd AD			plot scale
date month/day/yr 1/6/2012	design approved ———		dist. code
scale Not To Scale	authorized		electronic filename 110229–E3 RA.DWG
w.o.			
dwg no 110229–E3			rev A

NIAGARA-ON-THE-LAKE HYDRO

DISTRIBUTION SYSTEM PLAN

APPENDIX

G

NOTL MTS#2
T2 Tap Changer Failure Investigation

Niagara-on-the-Lake Hydro

Prepared by: Matt Betts, C.E.T.
May 1st, 2018

560 Sheldon Drive
Cambridge ON.
N1T 0A4

Telephone: (519) 620-4414
Fax: (519) 620-4413
www.eptcon.com

May 1st, 2018 Reference No.: 1532T

Niagara-on-the-Lake Hydro
8 Henegan Rd.
PO Box 460
Virgil, Ont.
L0S 1T0

Attention: Mr. Kazi Marouf

Subject: NOTL MTS#1 T2 Tap Changer Failure Investigation

Dear Sir:

On April 11th, 2018, our Technical Services Department began conducting an investigation on an apparent failure of the On-Load Tap Changer (OLTC) of T2 at NOTL MTS#2 Substation, which occurred in the early hours of April 3rd, 2018.

Shortly after the event, an oil sample was taken and analyzed. On April 10th, a preliminary visit was made to observe the condition of the transformer and OLTC, as well as gather information pertinent to the event. On April 11th, the OLTC compartment was drained of oil and testing and visual inspection was commenced. Diagnostic electrical tests were performed both before and after the OLTC compartment was drained of oil.

Our investigation included:

- Oil analysis
- As-found turns ratio measurements
- As-found power factor and capacitance measurements
- As-found winding resistance measurements
- Visual inspection of the tap switch
- Operational checks of the tap switch
- Post-operational resistance measurements
- Excitation tests applied to LV windings on every tap
- Ratio and winding resistance measurements applied directly to fixed contacts (to assess main transformer windings without influence of the tap switch)
- Electrical testing of downstream equipment (metering unit, station service transformer, voltage control PT, and bushing CT for Winding Temperature Indication)

The results of our investigation has concluded that no damage appears to have occurred to the main transformer windings of T2 or any downstream equipment, but the OLTC <u>should not be returned to service</u> in its current condition.

Below you will find our observations and analysis.

Should any questions arise regarding this or any other matters, please do not hesitate to contact the undersigned.

Sincerely,
EPTCON Ltd.

Matt Betts, C.E.T.
Technical Service Representative

560 Sheldon Drive
Cambridge ON.
N1T 0A4

Telephone: (519) 620-4414
Fax: (519) 620-4413
www.eptcon.com

Table of Contents

May 1st, 2018 Reference No.: 1532T

1 Nameplate Data

Make	Westinghouse
Serial No.	A355672
Year	1983
Voltage	115500 – 29500 Dyn1
MVA	15/20/25
Type	ONAN/ONAF/ONAF
Impedance	8.46% at rated tap, 15 MVA
No. of Taps	21 (11 available)
Tap Changer Make	ASEA
Serial No.	2285 139
Tap Changer Type	UZERN 200/600
Mechanism Type	BUF 3
No. of Operations	59530 (counter faulty)

2 Purpose of Investigation

EPTCON Technical Services were dispatched to investigate an apparent internal fault of the tap changer by which oil was expelled from the pressure relief device.

3 Background

EPTCON Technical Services was made aware that in the early hours of April 3rd, 2018, the On-Call Dispatch received a high temperature alarm on T2. When NOTL personnel arrived at site, they observed that the OLTC was "smoking and oil was everywhere." They immediately opened the T2-Q11S Circuit Switcher to remove T2 from service. At the time of the event, T2 was "on pot" only, as work was being done on F4, the only load normally associated with T2.

4 Observations

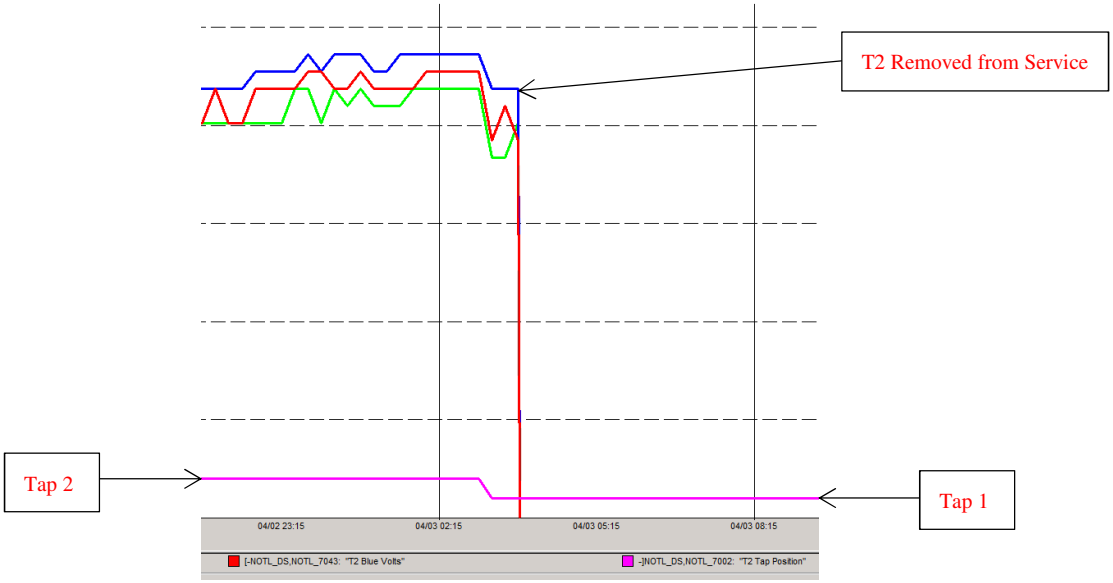
4.1 Initial Visual Inspection

Upon arriving at site, the ambient temperature was approximately 5 degrees. The following was noted:

Main Tank Oil Level	-25 deg C
OLTC Oil Level	Almost at MIN
Oil Temperature	5 deg C
Maximum Oil Temperature	60 deg C
Maximum Winding Temperature	132 deg C
Tap Position	Slightly off 2 towards 1 (was assumed to be on 2)

- No evidence of oil eruption from main tank
- PRD semaphore on OLTC had been deployed, but switch was not latched (was determined that latch no longer works, but switch contacts are operational)
- No active alarms on relay front panels
- No evidence of damage to other equipment

It was later determined that at the time of the event, the tap changer had changed tap position from Tap 2 to Tap 1:



4.2 As-Found Electrical Testing

The "as-found" electrical tests were a series of tests and measurements that were performed prior to disturbing the transformer in any way. This means that the tests were conducted only on the tap found and that the tap changer was not operated prior to conducting the tests.

The first test to be conducted was the *As-Found Turns Ratio*. The results of this test indicated that the tap was actually on Tap 1 and not Tap 2, contrary to what appeared to be the indication on the drive mechanism position indicator.

Phase	Measured Ratio	Calculated Ratio (Tap 1)	%Error (Tap 1)	Calculated Ratio (Tap 2)	%Error (Tap 2)
A-ph	7.5515	7.5349	.22	7.4319	1.61
B-ph	7.5512		.22		1.61
C-ph	7.5520		.23		1.62

The second test to be conducted was the *Power Factor and Capacitance* test. This test tests the integrity of the overall transformer insulation inclusive of the tap changer. The results of this test were normal.

Measurement	Power Factor (%)	Capacitance (pF)	Current (mA)	Watts-Loss (mW)
$C_H + C_{HL}$	.2488	6502.8	24.53	600.32
C_H	.2727	2052.0	7.75	211.34
C_{HL}	.2312	4450.8	16.78	389.91
C_L	.4231	9590.9	36.17	1530.29
$C_L + C_{HL}$	.3613	14042.0	52.95	1913.04

The final as-found test to be conducted was the *As-Found Winding Resistance* measurement. The results of this test were abnormal and warranted further investigation. The outer two phases were exhibiting values that were consistent but exceedingly high, and the middle phase would not stabilize in order to obtain a proper measurement.

X1-X0	X2-X0	X3-X0
.49376 Ω	.0026 Ω (estimated)	.51005 Ω

4.3 Tap Switch Internal Inspection

Approximately 500L of remaining oil was drained from the OLTC compartment and the access cover was opened. The oil was heavily carbonated and carbon was deposited extensively on the interior surfaces of the compartment and tap switch (Fig. 1). The amount of carbon observed could be attributed normal operation of the tap changer over an extensive period of time. Moisture was detected on the upper surfaces of the compartment above the oil line (Fig. 2). The source of the moisture appears to have been a deteriorated gasket associated with the PRD (Fig. 3).

The following observations were made:

- Significant cracks in epoxy fixed contact bushings on each phase (Fig. 4)
- B-phase transition resistors were heavily blackened with carbon deposits (Fig. 5)
- All 3 phases appear to be making contact only through 1 transition resistor and not through main moving contacts (Fig. 6)
- Significant and recent burn mark on C-phase Tap 2 fixed contact (Fig. 7)
- Significant pitting on C-phase transition contact (Fig. 8)

Fig. 1 – As-found condition of tap switch

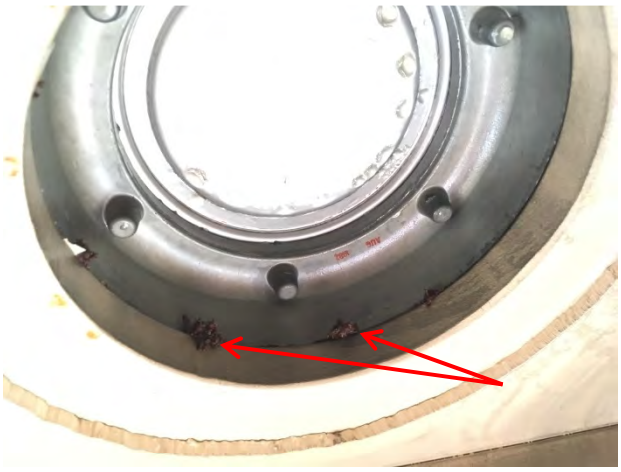


Fig. 2 (Left) – Moisture droplets can be seen on compartment wall
Fig. 3 (Right) – Underside of PRD showing deteriorated gasket

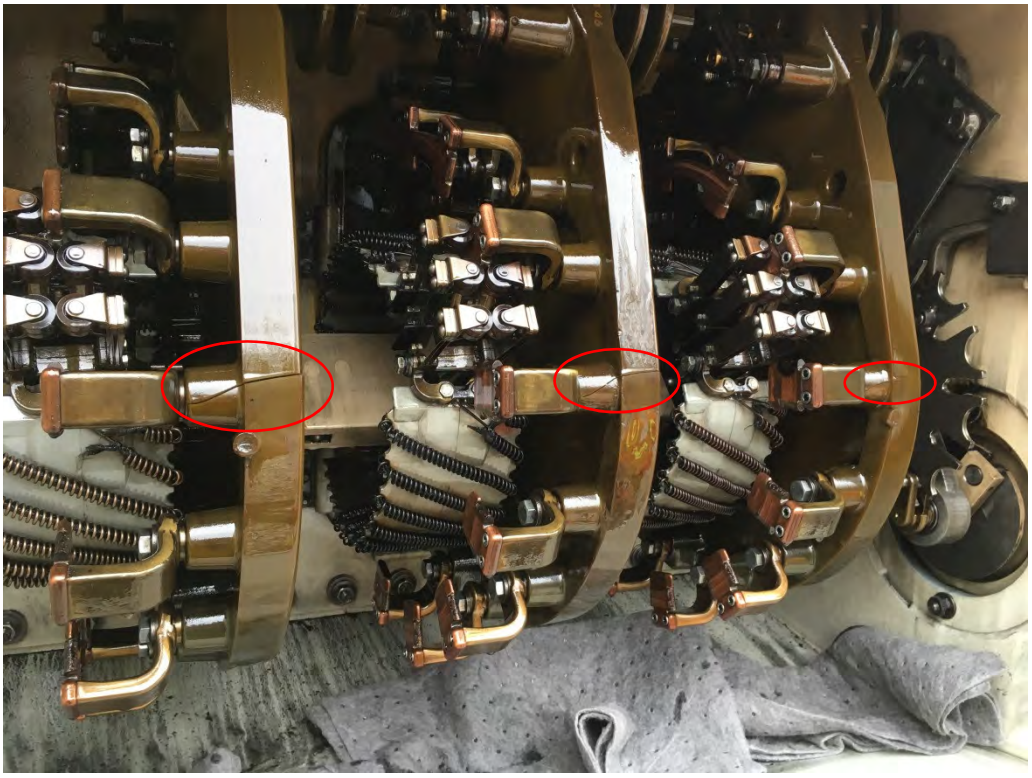


Fig. 4 – Cracks emanating from Tap 2 towards drive shaft.
Other smaller cracks were noted in various locations.

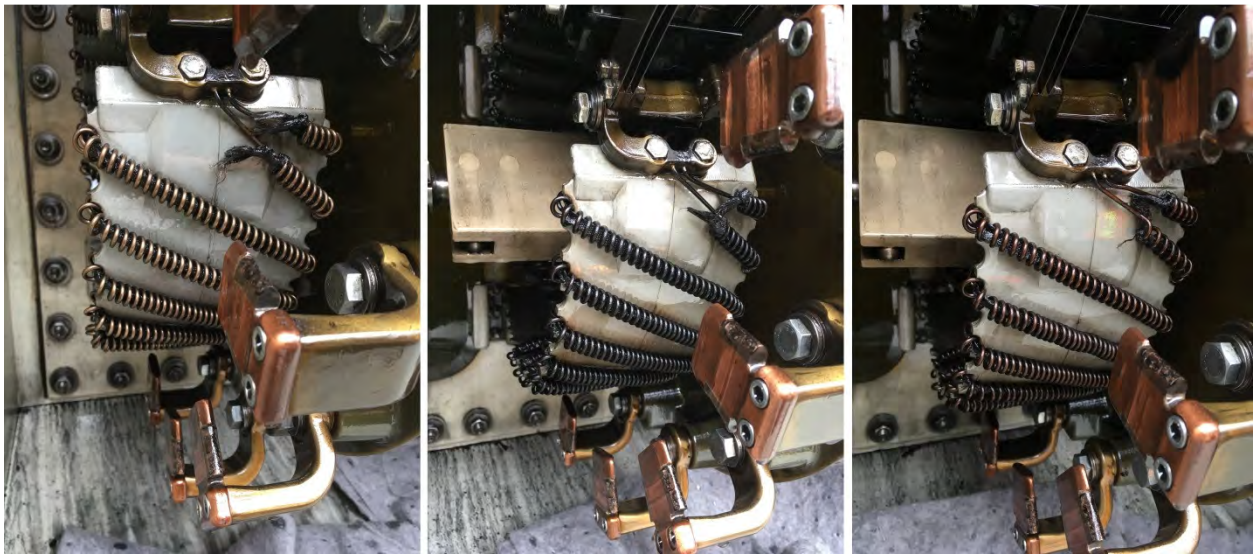
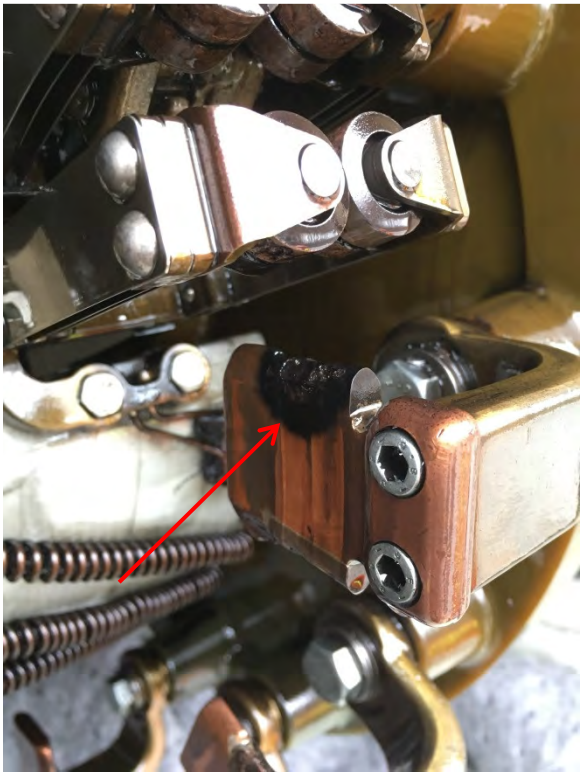


Fig. 5 – B-phase (centre) transition resistor can be seen to have significantly more carbon build-up than outer phases

Fig. 6 – Comparison between the as-found contact position and what the contact position should be. The outer rollers are the transition contacts and the centre rollers are the main moving contacts.



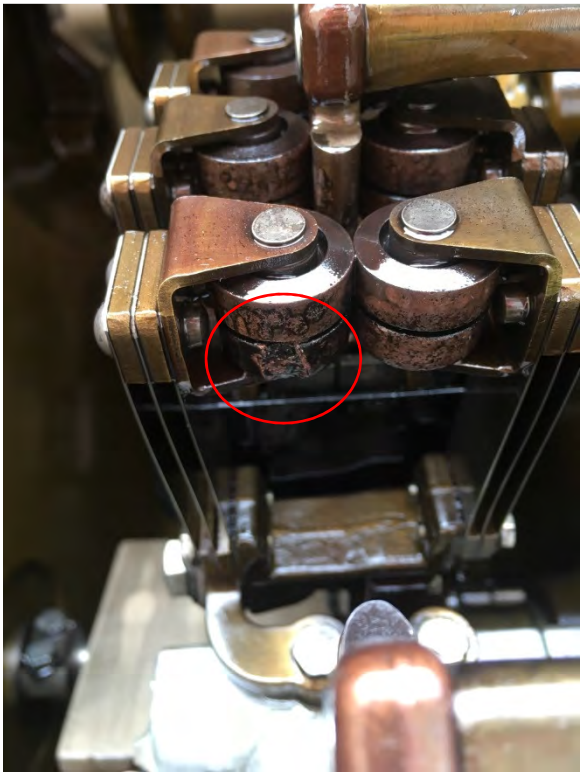


Fig. 7 (Left) – Burn mark can be seen on C-phase (X3) on Tap 2 Stationary Contact
Fig. 8 (Right) – Severe pitting on outer roller near Tap 2 on C-phase (X3)

4.4 Diagnostic Electrical Testing

After examining the OLTC and conducting operational checks both manually and electrically, diagnostic electrical testing was performed. It should be noted that the "off tap" position that the moving contacts were initially found in could not be recreated. Every tap change during the inspection resulted in adequate contact between the main moving contacts and the fixed contacts.

After operating the tap changer several times, the *Winding Resistance* was again measured on Tap 1. The results of this test appeared normal.

X1-X0	X2-X0	X3-X0
.073755 Ω	.073840 Ω	.073635 Ω

The transition resistors were also measured.

Measurement	X1-X0	X2-X0	X3-X0
Lower TR	.51 Ω	.51 Ω	.51 Ω
Raise TR	.52 Ω	.51 Ω	.51 Ω
Total	.96 Ω	.96 Ω	.94 Ω

Excitation Current was measured on every tap by applying 10 kV to each phase at a time on the LV winding. This test is used to determine if there are any abnormal changes to the inductive properties of the transformer and tapping windings. The results of this test were normal.

Tap	X1-X0 (mA)	X2-X0 (mA)	X3-X0 (mA)
1	210.31	152.39	208.50
2	205.10	148.69	203.86
3	200.15	145.14	199.57
4	195.44	141.73	195.39
5	190.44	138.44	191.29
6	186.58	135.28	187.33
7	182.37	132.22	183.48
8	178.29	129.26	179.75
9	174.71	126.43	176.07
10	170.96	123.66	172.54
11	167.20	121.00	169.04

In order to guarantee that there was no damage to the main windings of the transformer as a result of the OLTC failure, the *Turns Ratio* and *Winding Resistance* tests were conducted again directly on the fixed conductors of the tap switch. By conducting the tests in this manner, there could be no influence of poor contact condition or other malfunction on the measurement. This was achieved by removing the fixed contacts of Tap 2 from the conductors to which they are connected by two socket-head cap screws each. The OLTC was then placed in the Tap 2 position where no contact could be made. However, by doing so, the natural star point of the LV winding was essentially disconnected, which was problematic for the *Turns Ratio* test. To recreate the star point, the X1, X2, and X3 bushings were joined together, which in turn changed the vector grouping by inverting the winding polarities. This was accounted for while conducting the *Turns Ratio* test. The *Winding Resistance* measurements were able to be taken simply between the bushing terminal and fixed contacts for each phase.

The results from the *Turns Ratio* test conducted directly via the fixed contacts were normal.

Tap	Calculated	A-ph	B-ph	C-ph
1	7.5349	7.5553	7.5572	7.5536
2	7.4319	7.4503	7.4525	7.4484
3	7.3311	7.3503	7.3519	7.3488
4	7.2336	7.2514	7.2523	7.2488
5	7.1383	7.1550	7.1573	7.1541
6	7.0456	7.0621	7.0638	7.0592
7	6.9552	6.9714	6.9730	6.9687
8	6.8673	6.8826	6.8842	6.8805
9	6.7814	6.7964	6.7981	6.7936
10	6.6976	6.7114	6.7136	6.7100
11	6.6159	6.6298	6.6313	6.6279

The results from the *Winding Resistance* test conducted directly via the fixed contacts were normal.

Tap	X1-X0 (Ω)	X2-X0 (Ω)	X3-X0 (Ω)
1	.073755	.073845	.073710
2	.072410	.072560	.072480
3	.071455	.071600	.071520
4	.070460	.070610	.070515
5	.069485	.069645	.069535
6	.068500	.068665	.068535
7	.067525	.067690	.067555
8	.066545	.066705	.066580
9	.065585	.065735	.065610
10	.064595	.064765	.064625
11	.063350	.063580	.063505

Further testing was conducted on equipment that was connected to T2 at the time of the event in order to assess the condition of that equipment and assure that there was no damage. The equipment tested included:

- SS2
- T2-MO (PT and CT circuits)
- T2 tap changer voltage control PT

The WTI bushing CT on T2 was also tested in an attempt to determine the cause of the high winding temperature that was initially reported.

All equipment tested normal.

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5 Analysis

Based on careful review of the background information, observations, mechanical checks, photographs, and test results, it is believed that the following scenario was likely to have occurred:

1. The tap changer was initially on Tap 2 and was called to change to Tap 1.
2. During the tap change, a severe arc occurred on C-phase and caused the contacts to temporarily weld together.
3. The welded contacts prevented the tap change from completing and the moving contacts bridged Tap 1 and Tap 2.
4. The difference in potential between Tap 1 and Tap 2 caused a circulating current to flow through the transition resistors in the range of approximately 370 A. Because of the arc temporarily welding the contacts on C-phase, this current was allowed to flow for an excessive amount of time.
5. B-phase appeared to be slightly "ahead" of the other two phases after closer observation. It is believed that due to the age of the OLTC, there had been some slippage in the drive linkages causing B-phase to be slightly ahead. This was confirmed by the initial winding resistance measurements, which appeared to be dominated by one of the transition resistors on A and C-phase. The fluctuating B-phase resistance was possibly from the main moving contact making poor contact with the fixed contact.
6. It is further believed that B-phase likely did not bridge Taps 1 and 2 for as long if at all. It is believed that the intense heat from the currents flowing through A and C-phases caused the carbon deposits to burn off the transition resistors, similar to a self-cleaning oven.
7. The power dissipated from the currents flowing through the A and C-phase transition resistors would have been approximately 137 kW each. This heat caused the oil to burn, boil, and pressurize the OLTC compartment resulting in the release from the PRD.
8. It is believed that when the arc finally released on C phase, there was not enough kinetic energy left in the drive system to adequately complete the tap change leaving the moving contacts in the position as found.

It is unclear as to why the Winding Temperature Indicator reached as high as 130 degrees. Based on the assessment of the connected equipment, the extremely high load current that would have to flow through X2 in order for the WTI to reach 130 degrees did not occur. It is possible that more investigation into the WTI heater circuit may be necessary as the WTI bushing CT was found to be in good condition.

The cracks that were discovered in the epoxy fixed contact bushings were likely caused by some mechanical stress that acted on all 3 phases. There is no conclusive evidence to indicate that the cracks occurred during this fault. The stress could have been applied during a malfunction

during a tap change operation, or it has been suggested that the cracks are the result of over-torqued contacts that propagated over time.

The water content and low dielectric strength that was detected by the oil analysis may have contributed to the failure by preventing the oil in the OLTC compartment from extinguishing the arcs properly during tap change operations. Free water was detected in the sample which is indicative of moisture actively migrating into the oil system. This was confirmed by visually observing oil droplets within the OLTC compartment and the source was determined to be a deteriorated gasket on the PRD.

6 Conclusion

Photographs and details of the event had been submitted to ABB for their review and comment. It has been advised by ABB that the tap changer not be returned to service in its current condition. This view is shared by EPTCON Technical Services. Most concerning is the cracking of the epoxy fixed contact bushings, which under continued operation will most certainly lead to complete failure. ABB has also noted that there are obsolete components present which should be replaced during an overhaul.

EPTCON Technical Services does not believe that an overhaul of this tap changer would be economical considering a more modern version is available on the spare transformer at NOTL MTS#2. It is recommended that the spare OLTC be assessed and considered for overhaul depending on its condition in order to replace the failed OLTC on T2. T2 itself, based on the test data obtained during this investigation, appears to be healthy. Therefore, either the spare transformer can be assessed, serviced, moved, and commissioned in order to replace T2, or, the spare tap changer can feasibly be removed and installed on T2 to replace the failed tap changer. Both options are technically viable and EPTCON Technical Services believes that the former option would be the quickest, least intrusive, and most economical solution.

It should be noted that the above options are recommended as a stopgap only until NOTL Hydro proceeds with a plan to completely replace T2 with new, especially considering the ages of both T2 and the spare. The spare was retained only for rapid replacement in an emergency, or for spare parts, as the assessment of both deemed T2 to be in better condition when the new transformer was installed a couple of years ago to replace T1.

APPENDIX

2B

2019

NIAGARA-ON-THE-LAKE HYDRO

COST OF SERVICE RATE APPLICATION

EB-2018-0056

1. **Purpose:** To document the company policies for compliance with International Accounting Standard IAS16 as part of future conversion to IFRS accounting requirements.

2. **Scope:**

Currently, the mandatory date of implementation to IFRS, according to the Accounting Standards Board of Canada, is January 1, 2014[1]. NOTL Hydro has chosen not to change to IFRS before January 1, 2014. Thus, if the mandatory date remains at January 1, 2014, NOTL Hydro's financial statements for the fiscal year 2014 will be in IFRS, with historical results for 2013 stated in both CGAAP and IFRS. NOTL Hydro's 2012 and 2013 financial statements will remain in CGAAP accounting.

However, the Ontario Energy Board, by letter dated July 17, 2012, requires that policies for componentization and depreciation[2] and for capitalization (burdens)[3] for the fiscal year 2013 will be in accordance with IFRS, even though the LDC may remain under CGAAP in 2013, as will be the case for NOTL Hydro. LDCs are permitted to make this accounting change in 2012. However, NOTL Hydro has chosen not to make the change until 2013.

3. **Policy:** The "Conclusion Documents"[4] in the following pages provide NOTL Hydro's policies in relation to IAS16 standards for:

- Componentization and Depreciation
- Capitalization – Burdens
- Property, Plant and Equipment – Fair Value vs. Carrying Value as Deemed Cost
- Property, Plant and Equipment – Measurement after Recognition
- Property, Plant and Equipment – De-recognition
- Property, Plant and Equipment – Borrowing Costs

1 This date is sometimes referred to as the "IFRS Changeover Date". The "IFRS Transition Date" is the beginning of the previous year, in this case January 1, 2013 from which date IFRS comparative figures are required for the 2014 financial statements.
2 See 1st item under "Policy"
3 See 2nd item under "Policy"
4 These documents were prepared with the guidance of KPMG on technical IFRS accounting matters.

Conclusion Document

Standard: IAS 16 – Property, Plant and Equipment

Topic: Componentization and Depreciation

Objective:

To document the accounting policy on componentization and depreciation of property, plant and equipment for Niagara-On-The-Lake Hydro Inc. ("the company")

Background:

Each part of an item of property, plant and equipment (PP&E) with a cost that is significant in relation to the total cost of the item shall be depreciated separately.

An entity should allocate the amount initially recognized in respect of an item of PPE to its significant parts to be depreciated separately.

A significant part of an item of PP&E may have a useful life and a depreciation method that are the same as the useful life and the depreciation method of another significant part of that same item. Such parts may be grouped in determining the depreciation charge.

Depreciation is to be computed on a systematic basis over the estimated useful life of the item of PP&E. The depreciable amount of an asset is determined after deducting its residual value. In practice, the residual value of an asset is often insignificant and therefore immaterial in the calculation of the depreciable amount.

The residual value and the useful life of an asset shall be reviewed at least at each financial year-end and, if expectations differ from previous estimates, the change(s) shall be accounted for as a change in an accounting estimate in accordance with **IAS 8** *Accounting Policies, Changes in Accounting Estimates and Errors.*

Depreciation of an asset begins when it is available for use (i.e. when it is in the location and condition necessary for it to be capable of operating in the manner intended by management). Depreciation of an asset ceases at the earlier of the date that the asset is classified as held for sale in accordance with **IFRS 5** and the date that the asset is derecognized.

Considerations:

Significant components of PP&E will be separately accounted under IFRS. Each significant component and the estimated useful lives, for purposes of computing depreciation expense under IFRS, will be set out in Table 1 as attached.

<u>Overhead system</u>

Four components identified – Poles, OH Conductors/Switches, Transformers and OH Secondary Cable.

The company currently has only wood poles and has determined that there are no components of the pole that are material in dollar value or have a significantly different useful life. Therefore, the company has concluded that there is only one component comprised of the fully dressed wood pole. This component includes the standoff brackets and guy wires which are considered immaterial.

In terms of useful life, the Kinetrics report gave a range of 35-75 years, with the typical being 45 year. The company considered the following factors with respect to the useful life of the poles. Mechanical stress and environmental factors are high and medium, respectively. The poles are not overloaded with weight, as the system has the typical length between poles. Historical experience shows the poles are being replaced between 45-50 years. The company has determined a useful life of 45 years is appropriate.

The company currently includes conductor and switches in the same GL account. It has been determined that switches do not make up a significant share of the account. Going forward, it is not expected there will be material amounts of switches added that justifies a separate component. The company also determined that they are not replacing conductor more often than switches or re-closers, which has led to the determination of a single component for these assets. The company has a regular maintenance program on the switches and as a result, failure is not typical.

In terms of useful life, the Kinetrics report gave a range of 50-75 years (typical 60 years) for OH conductors and 30-55 years (typical 45 years) for line switches. The company has determined its conductors fit the typical life span, given historical experience and pole spans being typical (which reduces strain on the conductor). Since switches were determined to be immaterial in this component, a useful life of 60 years is appropriate. Typically, switches are only replaced prior to replacing the conductor, when the switch fails. Failure is not typically seen with the exception of lightning strikes.

Overhead and underground transformers are currently grouped together. Useful lives of the two types of transformers are expected to be similar since the system is not overloaded. There are no plans to remove underground transformers from service prior to 40 years unless they are overloaded. Kinectrics useful life range is 30 to 60 years with typical of 40 years. Electrical loading and mechanical stress are low and environmental factors are considered to be normal. Kinectrics typical useful life is based upon moderate electrical loading. The company's low electrical loading would extend useful life beyond the typical range. Life should be 45 years based upon the utilization factors.

Secondary cable (Services) has been classified into two separate components (underground and overhead) due to the significantly different useful lives based on the type of wire used for each. Overhead wire is PILC (covered wire).

OH secondary cable experience tree wear from rubbing. The cable is insulated, which tends to deteriorate over time. The company's experience has shown this cable does not last longer than about 60 years. A useful life of 60 years is considered appropriate.

TS Stations

Two components identified – Transformers and Other

The company has assessed the different assets that comprise the two TS currently owned. The unique parts are power transformers, stations switch, breakers and switches, relays, bus-bars and steel structures. The company has determined the power transformers are by far the most significant component in the TS stations and should be accounted for as a separate component.

The other components are not considered material and useful lives are not significantly different to warrant any further componentization for the other assets comprising the TS station.

Kinetrics life range for the transformers is 30-60 years with 45 being typical. The company does not have much experience with the life span of this component as the oldest asset is from 1985. Electrical loading and environmental factors do not differ from Kinetrics typical, which is moderate. Typical useful life of 45 years is appropriate.

The other assets component (stations switch, breakers and switches, relays, bus-bars and steel structures) have a life range of between 30 and 60 years with typical being 50 years. The station switches and breakers etc. are regularly maintained and the operational practices of the switches are low to moderate which would suggest a higher useful life than typical. 55 years is considered an appropriate life.

DS Station

The King St. DS Station is expected to be decommissioned in 2013. Based on the expected decommission, the useful life of this asset on January 1, 2013 will be one year.

Underground System

Three Components identified – Underground Cable (Primary) & Devices, Underground Conduit and Secondary Cable (Underground)

The company has determined that underground primary cable and devices represent a single component. The assets in this class have similar useful lives. The Kinetrics report gives useful life ranges of 35-55 years (typical 40 years). The company's assets in this component include both direct buried and in duct, with the majority being in-duct (direct buried has a lower life and only in one or two subdivisions). Mechanical stress, electrical loading, and environmental conditions are considered moderate in the Kinectrics report, but the company has assessed electrical loading as lower. The company has also considered historical experience for these assets. There is currently direct buried cable with a life of 30 years in operation and it is expected that these will last at least 10 more years as no major issues have been encountered at 30 years of life. Based on these factors, the company has assessed these assets with a useful life of 45 years, higher than typical based upon the low electrical loading.

The company has determined that ducts, foundations, vaults and duct banks all form the Underground Conduit component. These assets have similar useful lives. The Kinetrics report gives useful life ranges from 30-85 years for these assets (typical 50-55 years). The company has assessed mechanical stress lower than Kinetrics report (assets are under grass not under roads) which leads to a longer expected life. The company has assessed 65 years as appropriate for these assets.

Secondary cable (Services) has been classified into two separate components (underground and overhead) due to the significantly different useful lives based on the type of wire used for each. Overhead wire is PILC (covered wire).

The Kinectrics report has the useful life of underground secondary cable as a range of 35-60 years (typical 40 years). The company has determined there are no factors that would suggest the useful life is any different from the underground primary cable. As such, a useful life of 45 years is appropriate.

SCADA software: Has been assessed as a single component, since radios are already included under communication equipment. The company is aware this software is updated on an irregular basis (that may exceed annual) but the original firmware may be considered to have a

useful life of 8-10 years before it is completely replaced. Therefore a useful life of 10 years has been chosen for this component.

Minor assets

Office Equipment: Has been assessed as a single component as assets have similar useful lives. The current useful life is 10 years, and there are no indications this should change.

Vehicles < 3 tonnes: Single component. Policy is to replace after 5 years, therefore this is the useful life.

Vehicles > 3 tonnes: Single component. Policy is to replace after 10 years, therefore this is the useful life.

Trailers: Single component. Estimated useful life is 15 years based upon planned replacement cycle.

Administrative Buildings: Single component. Kinetrics report gives useful life of 50 – 75 years. The company's administrative building is fairly new. The building was constructed under a low budget (minimum standards) which indicates the maximum useful life is not appropriate. A useful life of 60 years has been determined.

Station Buildings: It has been determined not to separate these assets out from the TS (insignificant in relation to the equipment in the TS station)

Computer Equipment (Hardware): Single component. Policy is replacement every 3 years; therefore the useful life is 3 years.

Computer Equipment (Software): Single component. Policy is replacement every 3 years; therefore the useful life is 3 years. Technological obsolescence limits the life.

Communication Equipment: Single component that includes a computer station that works with the SCADA equipment, towers, radio and phone system. The company does not have any reason as to why this should vary from the rate it is currently being depreciated over, which is 10 years. This component is subject to technological obsolescence so anything higher than 10 years would not be appropriate.

Miscellaneous Equipment (tools and shop): Single component. Based on experience, assets in this class can last 5-10 years, but individually the assets are immaterial. As such, an average life of 8 years is considered appropriate.

Miscellaneous Equipment (stores and warehouse): Single component. The company has assessed at maximum life of 10 years based on Kinetrics report and experience with life of shelving equipment.

Meters: 4 Components were decided

1) Smart Meters: These are material and have a significantly different useful life (no history yet on how long they will last). The company discussed the need to split out into further components (data collectors). It was determined that useful life of data collectors and the meter are similar and therefore no need to break down into further components. The company does not expect useful life to exceed 10 years given problems already encountered with these meters. However, will use same rate as industry (15 years) and assess the appropriateness of this at end of each reporting period.

2) Stranded Meters: Life kept at OEB rate of 25 years.

3) Other Meters: These meters have been lasting 25 years. Technological obsolescence will limit the life of these assets to a certain extent so extending this beyond the 25 years is not appropriate.

4) CT's and PT's: These are material and have a significantly different useful life. Kinetrics report indicates a range of 35-50 years. The company has determined a 40 year life is reasonable for these assets.

Conclusion:

The new levels of componentization and the corresponding useful lives will be applied beginning January 1, 2013[5]. The net book value as deemed cost exemption (available to rate regulated entities) will be applied so that the opening values at January 1, 2013[6] do not need to be restated and therefore, componentization does not need to be applied retroactively.

[5] *This date assumes the current mandatory IFRS implementation date (or "changeover date") of January 1, 2014, which requires 2013 historical data in 2014 financial statements to be in both CGAAP and IFRS.*
[6] *See Footnote above*

Table 1: Niagara-On-The-Lake Hydro – PP&E Components and Estimated Useful Lives

Component	Previous Component	Proposed Useful Life	Existing Useful Life
Poles	1830 -	45	25
OH Conductors and Switches	1835 -	60	25
Transformers (UG and OH)	1850 -	45	25
Transformers (Substation)	1815-1051 (York) and 1815-1052 (NOTL DS)	45	40
Station Switch, Breakers, Bus-bars	1815-1051 (York) and 1815-1052 (NOTL DS)	55	40
DS Station	1820 -	1 year [i.e. 2013]	25
UG Conductors and Devices	1845 -	45	25
UG Conduit	1840 -	65	25
UG Services	1855-1135 -	45	25
OH Services	1855-1130 -	60	25
SCADA	1980 -	10	15
Office Equipment	1915 -	10	10
Trucks (<3 tonnes)	1930 -7102 -	5	5
Trucks (>3 tonnes)	1930 -7103 -	10	8
Trailers	1930-7104 -	15	5
Administrative Buildings	1908-1030	60	50
PCB Shed	1908-1031	30	30
Computer Hardware	1920 -	3	5
Computer Software	1925 -	3	3
Communication equipment	1955 -	10	10
Miscellaneous Tools	1940 -	8	10
Stores and Warehouse equipment	1935 -	10	10
Stranded Meters	1860 -	25	25
Other Meters	1860 -	25	25
CT/PT	1860 -	40	25
Smart Meters	1860[7]-	15	N/A
Smart Metering – Data Collectors	1860[8]-	15	N/A

[7] *Previously 1555, prior to OEB approval of disposition of the variance account.*
[8] *See footnote 7*

Conclusion Document

Standard: IAS 16 – Property, Plant and Equipment

Topic: Capitalization - Burdens

Objective:

To document the accounting policy on the capitalization of burdens.

Background:

Core Principle

The cost of an item of property, plant and equipment (PP&E) is recognized as an asset if and only if:

a) It is probable that future economic benefits will flow to the company; and
b) The cost of the item can be measured reliably.

The cost of an item of PP&E includes any costs that are directly attributable to bringing the asset to the location and condition necessary for it to be capable of operating in the manner intended by management.

Certain costs are explicitly prohibited from inclusion as costs of an item of PP&E:

a) Costs of opening a new facility;
b) Costs of introducing a new product or service (including advertising and promotion);
c) Costs of conducting business in a new location or with a new class of customer (including costs of staff training)
d) Administration and other general overhead costs; and,
e) Day-to-day servicing costs.

IAS 16 does not indicate what constitutes an item of PP&E. Judgment is required when applying the core principle.

Directly attributable

The term “directly attributable” is not defined in IAS 16. The specific facts and circumstances surrounding the cost and the ability to demonstrate that the cost is directly attributable to an item of PP&E is critical to establishing whether the cost should be capitalized. The cost must be attributed to a specific item of PP&E at the time it is incurred. The incurrence of that cost should aid directly in the construction effort, making the asset more capable of being used than if the cost had not been incurred.

General and administrative overhead

IFRS does not provide a definition of general and administrative overhead (G&A). The specific facts and circumstances surrounding the nature of the costs and the activity associated with it must be considered to determine if it is directly attributable to an item of PP&E.

G&A costs typically benefit the organization as a whole or areas of the organization more broadly rather than contributing directly to bringing a physical asset to the location and condition necessary for it to be capable of operating in the manner intended by management. The more the nature of a particular cost strays from being directly attributable to an item of PP&E, then the more likely it is that the cost will be determined to be in the nature of G&A.

Day-to-day servicing costs

Day-to-day servicing costs are defined as costs of labour and consumables and may include the cost of small parts. The purpose of these expenditures is often described as for the “repairs and maintenance” of the item of PP&E.

Feasibility studies and pre-construction activities

Normally, feasibility studies are not capitalized under IFRS as these costs do not always result in asset construction, and therefore may not meet the criteria of providing a future economic benefit. Additionally, the associated costs must be directly attributable to an item of PP&E. Pre-construction activities (such as design work) prior to a decision to go ahead with a capital project do not qualify for capitalization.

Considerations:

Canadian GAAP allowed for capitalization of general and administrative overhead, training costs, etc. while IFRS does not.

The Ontario Energy Board (OEB) requires electricity distributors to be in full compliance with IFRS requirements as applicable to non-regulated enterprises and only where Board authorizes specific alternative treatment for regulatory purposes is alternative treatment acceptable.

Niagara-On-The-Lake Hydro (“the company”) performed a review of the costs currently included in burdens to assess recognition criteria as an item of PP&E under IFRS.

Payroll allocation

Payroll allocation consists of the following benefits paid to employees: health benefits such as drugs, dental/vision, LTD, out of country medical, OMERS, WSIB, Employment insurance, CPP, EHT, and down time (which includes vacation, sick time, bereavement pay). IAS 16 specifically allows for benefits as defined in IAS 19 arising directly from the construction or acquisition of an item of PPE to be included as a directly attributable cost. The payroll allocation is allocated to capital based upon labour dollars charged to capital. Benefits are accumulated in the general ledger for all employees and allocated based upon where the employees charge their time (capital, maintenance, other operating, etc.). The company does not include training costs in payroll burden and downtime due to inclement weather is also not included in payroll burden.

No changes were identified for this burden under IFRS.

The following benefits were considered for inclusion in the burden rate as follows:

Truck allocation

Truck allocation consists of fuel, vehicle maintenance labour, repair parts, licenses and license renewals and amortization. Insurance is currently not included in the burden; however, the company will include insurance costs upon adoption to IFRS. Trucks and company vehicles are used on the job site and are directly related to the construction of an asset as they are required to construct the asset and are dedicated to the asset for a period of time. Truck expenses are allocated to capital based upon the time used on the job site.

With regards to repairs and maintenance costs, the company must decide whether the IFRS standard on this topic precludes capitalization of any repairs and maintenance costs or just specifically the repair and maintenance of the particular item (vehicle) repaired. For example the repairs and maintenance on a truck are not capitalizable to the cost of the truck (IAS 16.12), however an argument can be made that it is capitalizable to the specific capital job the repaired truck was assigned to such as a pole line construction. The company will interpret IAS 16.12 to apply only to repairs and maintenance of an item of PPE. Therefore repairs and maintenance cannot be capitalized to the cost of the item repaired. The company has determined that the repairs and maintenance account (account 91009102) can be included in the burden rate and be capitalized to the cost of a constructed asset when a vehicle is used on the job site for the construction of the asset.

Fuel, amortization (of the truck), truck insurance and license renewals can be capitalized because they are costs required to keep the trucks in running order and are not specifically excluded from capitalization in IAS 16 and they are directly attributable when used to construct an asset and bring it to its intended use. Amortization is currently included in the truck allocation under CGAAP, and the company will continue to include amortization under IFRS.

Stores allocation

The company noted that inventory is not currently recorded at cost. Inventory is recorded at cost plus (cost +10%, which represents the stores burden). This grossed up cost is charged to the specific job when the inventory item is used on the job.

Under IFRS, general and administrative expenses are not capitalized. General and administrative expenses tend to benefit the organization as a whole rather than a single job (or item of PPE) Typically, maintaining stores are more efficient than having parts delivered directly to the job site as they are needed. The company discussed whether stores costs should be capitalized or expensed. The company has structured its operations such that the time needed in stores is actually directly attributable. For example, there is no full time position in stores, but rather when stock is received, it is specifically tracked in the warehouse and segregated for the job for which it is intended. This leads to the conclusion that this time is directly attributable to specific jobs. Further, it would not be difficult for the staff person to track their time to specific jobs if required. The stores burden will continue to be charged to the capital job

Conclusion:

The company will capitalize all costs, including the above burdens, when the cost is directly attributable to bringing the item of PP&E to the location and condition necessary for it to be capable of operating in the manner intended by management.

Any general and administrative costs currently included in the various burden rates, such as training and other administrative expenses, will not be capitalized.

The following changes were made to the capitalization policy as a result of the transition to IFRS.

Payroll allocation

No changes were identified for this allocation.

Truck allocation

Insurance will be capitalized under IFRS.

Stores allocation

No changes were identified for this allocation.

Conclusion Document

Standard: IFRS 1 – Elective Exemption, IAS 16 – Property, Plant and Equipment

Topic: Property, Plant and Equipment – Fair Value vs. Carrying Value as Deemed Cost

Objective:

To determine the policy on initial measurement of property, plant and equipment (PP&E) on the date of transition to IFRS

Background:

Niagara-On-The-Lake Hydro Inc. ("NOTL") may elect to measure an item of PP&E at its fair value on the date of transition to IFRS. The fair value would then represent deemed cost at that date for purposes of subsequent measurement and amortization ("deemed cost election").

An additional IFRS 1 exemption is available to rate regulated entities. The exemption allows an entity to measure an item of PP&E at its previously recorded carrying value (i.e. net book value) on transition to IFRS. As NOTL's operations are rate regulated, they are eligible to apply this exemption.

If an Elective Exemption with respect to PP&E is not taken, NOTL would have to account for PP&E as if the requirements of IAS 16 had always been applied. This would require retrospective restatements of all PP&E balances in accordance with IFRS.

Considerations:

Retroactive restatements will be onerous and impractical as documentation for historical costs are not available.

The fair value exemption is not allowed by the OEB for rate setting purposes.

Fair values are more costly to obtain.

Electing the IFRS 1 exemption for rate regulated entities is more favourable to NOTL. Regulated Net Book Value ("regulated NBV") as at the date of transition to IFRS would be used for rate setting purposes. The OEB requires the use of regulated NBV as the basis for setting the opening rate base values upon transition to IFRS. Therefore, using the carrying value as deemed cost exemption would more closely align financial reporting with the basis in which regulated cash flows and income are determined by the regulator.

Conclusion:

NOTL has concluded that it will elect the IFRS 1 Exemption for rate regulated entities and use net book value as at date of transition to IFRS[9] as deemed cost.

[9] *The transition date is currently January 1, 2013 if the changeover date remains at January 1, 2014.*

Conclusion Document

Standard: IAS 16 – Property, Plant and Equipment

Topic: Property, Plant and Equipment – Measurement after Recognition

Objective:

To determine the policy on measurement of property, plant and equipment (PP&E) after initial recognition

Background:

For all subsequent periods following the initial recognition of an asset, IAS 16 permits a choice of using either the cost model or the revaluation model for valuing PP&E.

Cost Model

After recognition as an asset, an item of PP&E shall be carried at its cost less any accumulated depreciation and any accumulated impairment losses.

Revaluation Model

After recognition as an asset, an item of PP&E whose fair value can be measured reliably shall be carried at a revalued amount, being its fair value at the date of the revaluation less any subsequent accumulated depreciation and subsequent accumulated impairment losses. IAS 16 defines fair value as “the amount for which an asset could be exchanged between knowledgeable, willing parties in an arm’s length transaction.” It also mentions that, if there is no market-based evidence of fair value because of the specialized nature of a particular PP&E item and the item is rarely sold (except as part of a continuing business), an entity may need to estimate fair value using an income or a depreciated replacement cost approach.

Revaluation shall be made with sufficient regularity to ensure that the carrying amount does not differ materially from that which would be determined using fair value at the end of the reporting period. If an item of PP&E is revalued, the entire class of PP&E to which that asset belongs shall be revalued.

Ontario Energy Board

In its report of the Board on Transition to International Financial Reporting Standards, the OEB will require the use of historical acquisition cost as the basis for reporting PP&E for regulatory purposes.

Conclusion:

Niagara-On-The-Lake Hydro Inc. has concluded that it will choose the Cost Model to measure PP&E after initial recognition under IFRS.

Conclusion Document

Standard: IAS 16 – Property, Plant and Equipment

Topic: Property, Plant and Equipment – De-recognition of PP&E

Objective:

To document the accounting policy on de-recognition of property, plant and equipment.

Background:

The carrying amount of an item of property, plant and equipment (PP&E) shall be derecognized:

(a) On disposal; or

(b) When no future economic benefits are expected from its use or disposal (e.g. the item is removed from use).

When a part of an item of PP&E is replaced and that replacement is capitalized under the recognition principle in IAS 16, then the replaced part is derecognized regardless of whether the replaced part has been identified as a separate component and depreciated separately.

The gain or loss arising from the derecognition of an item of PP&E shall be included in profit or loss when the item is derecognized. Gains shall not be classified as revenue, and instead should be presented as other income or expense.

The disposal of an item of PP&E may occur in a variety of ways (e.g. by sale, by entering into a finance lease, by donation, etc.) In determining the date of disposal of an item, an entity applies the criteria in IAS 18 for recognizing revenue from the sale of goods. Under IAS 18.14, revenue from the sale of goods shall be recognized when all the following conditions have been satisfied:

(a) The entity has transferred to the buyer the significant risks and rewards of ownership of the goods

(b) The entity retains neither continuing managerial involvement to the degree usually associated with ownership nor effective control over the goods sold;

(c) The amount of revenue can be measured reliably;

(d) It is probable that the economic benefits associated with the transition will flow to the entity; and

(e) The costs incurred or to be incurred in respect of the transactions can be measure reliably.

The gain or loss arising from derecognizing an item of PP&E shall be determined as the difference between the net disposal proceeds, if any, and the carrying amount of the item.

Considerations:

Currently the pooled method of accounting for capital assets for Utility companies is applied and is an approved method by the Ontario Energy Board ("OEB").

The pooled method of accounting, pools like assets together based on the year of addition as the pooling method assumes that each asset will last, on average, their full useful life.

Under the pooled method there is an assumption that there are assets within the same asset pool which will last longer or shorter than the estimated useful life and therefore, in the end everything balances out on average. However, the assumption does not always hold true, especially if assets are removed from service before the end of their useful life, for example, when a road is widened.

Under the pooled method, if an asset is removed from service prior to the end of its useful life, there is no change to the accounting to remove the asset – it remains in the GL (i.e. it is not derecognized).

Currently, Niagara-On-The-Lake Hydro Inc. ("the company") records their capital assets using the pooled method of accounting and does not derecognize assets removed from service prior to the end of their useful life.

Since the company removes assets from service prior to the end of their useful life from time to time, these removed assets should be derecognized. The company must derecognize the cost of the asset which was removed/disposed. A write-off would be recorded in the amount of the remaining NBV of the asset removed/disposed. Any proceeds on the disposal of the asset would offset the write-off.

In order to properly account for assets that are removed from service in the accounting records, a process needs to be developed which alerts the accounting department when an asset has been removed from service in order to write-off the asset (long-term issue).

Conclusion:

For IFRS purposes a process will need to be developed and implemented which notifies the accounting department of changes which occur in the field which require accounting for the removal of the fixed assets and recording the loss in the income statement.

Conclusion Document

Standard: IAS 23 – Borrowing Costs

Topic: Property, Plant and Equipment – Borrowing Costs

Objective:

To determine the policy on accounting for borrowing costs for property, plant and equipment.

Background:

Borrowing costs are interest and other costs that an entity incurs in connection with the borrowing of funds. A qualifying asset is an asset that necessarily takes a substantial period of time to get ready for its intended use or sale. A substantial period of time is not defined in the IFRS standard. Guidance provided by KPMG suggests that a substantial period of time would be considered to be a period well in excess of 6 months.

For all subsequent periods following the initial recognition of an asset, IAS 16 permits a choice of using either the cost model or the revaluation model for valuing PP&E. Niagara-On-The-Lake Hydro Inc. ("NOTL") has chosen to use the cost model in accordance with the OEB requirements.

IAS 23 requires that borrowing costs be expensed as they are incurred unless they relate to "qualifying assets", in which case they must be capitalized if certain conditions are met. When interest is capitalized, IAS 23 requires the following steps:

- Begin capitalization when borrowing costs and expenditures are incurred and activities to develop a qualifying asset for its intended use are in progress;
- Suspend capitalization when development is interrupted for extended periods; and
- Cease capitalization when a qualifying asset is ready for its intended use or sale and all activities related thereto are complete.

Borrowing costs that are directly attributable to the acquisition, construction, or production of a qualifying asset form part of the cost of that asset. All other borrowing costs are recognized as interest expense.

The borrowing costs capitalized must reflect the weighted average of the actual borrowing costs incurred. The OEB requires the actual interest rate on the debt to be used if the related debt was acquired in an arm's length basis. If the debt is acquired in a non-arm's length basis then the interest rate used cannot exceed the Board's published rates for CWIP for rate setting purposes.

Definitions:

Qualifying asset – NOTL defines a qualifying asset as one that takes in excess of 6 months to construct or get ready for its intended use.

Considerations:

NOTL currently does not have any qualifying assets as the average time frame of constructing an item of PP&E typically does not exceed 6 months.

Conclusion:

Eligible borrowing costs will be capitalized as part of PP&E for all qualifying assets. Interest rate to be used for capitalization will be the actual cost of borrowing when debt is borrowed specifically to obtain the asset or the weighted average cost of borrowing when general borrowings are used to obtain the asset.