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Your ref: Docket No. 52-006
Our ref: DCP/NRC1609

August 5, 2003

SUBJECT: Transmittal of Oregon State University Procedures for APEX-1000 Test Program

Per your request, this letter transmits relevant Oregon State University procedures related to the APEX-1000 test plan. The procedures being furnished include:

1. OSU Advanced Thermal Hydraulic Research Laboratory Quality Plan, Rev. 3
2. OSU-D-03 APEX AP1000 Critical Instrument Channel Validation, Rev. 0
3. OSU-D-04 AP1000 Thermocouple Functional Check Procedure, Rev. 0
4. OSU-D-05 AP1000 Transmitter Channel Validation, Rev. 0
5. OSU-D-06 AP1000 Export Verification and Validation, Rev. 0
6. OSU-DAS-001 Data Acquisition System Functional Specification, Rev. 1

These procedures will be available for your review at the audit of the APEX-1000 test facility scheduled to begin on August 12, 2003.

Please contact me if you have questions regarding this transmittal.

Very truly yours,

M. M. Corletti
Passive Plant Projects & Development
AP600 & AP1000 Projects

/Attachments (6)

1. APEX-1000 Test Plan Procedures, Oregon State University

A020

OREGON STATE UNIVERSITY

DEPARTMENT OF NUCLEAR ENGINEERING
AND
RADIATION HEALTH PHYSICS

ADVANCED THERMAL HYDRAULIC RESEARCH LABORATORY

QUALITY PLAN

Revision 3.0

Submitted by: Jerry Schlaman — Aug 4, 03
Jerry Schlaman — Date

Reviewed by: John Groome — Aug 4, 03
John Groome — Date
Facility Operating Manager
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Approved by: José N. Reyes, Jr. — 8/4/03
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OSU Program Manager
Professor

OREGON STATE
UNIVERSITY

August 4, 2003

OREGON STATE UNIVERSITY
ADVANCED THERMAL HYDRAULIC RESEARCH LABORATORY

QUALITY PLAN
REV 3.0

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1.0 INTRODUCTION

This Quality Plan (QP) is applicable to all proposed testing programs to be performed at the OSU Advanced Thermal Hydraulic Research Laboratory. The purpose of this plan is to assure quality of the data by controlling all aspects of testing that affect the data.

2.0 ORGANIZATION

Team Member/Group	Role
OSU Program Manager	Overall responsibility for executing Sponsor's project requirements and ensuring applicable quality related activities performed by OSU are in compliance with this QP.
Facility Operating Manager	Responsible for testing and safe operation of the test facility. Supervises OSU personnel and certifies Operators and I&C Calibration Technicians.
Software Engineer	Responsible for the design, procurement, development and maintenance of the computer systems and software.
I&C Calibration Technicians	Responsible for all instrument calibration and reliability.
Operators & Test Engineers	Responsible for safely executing the Matrix Tests.

3.0 TRAINING AND INDOCTRINATION

Personnel performing or managing activities affecting quality, under this program, shall be trained in the quality requirements applicable to their scope of work.

Personnel performing or managing activities affecting quality shall be trained in:

- The requirements of this Quality Plan.
- Applicable specialized requirements, as described in Section 4.0.

4.0 SPECIALIZED TRAINING/QUALIFICATIONS

Facility Operating Manager shall:

1. Have a minimum of 2 years experience in the operation of similar facilities.
2. Be familiar with the calibration of test and data acquisition equipment.
3. Be trained in, or have demonstrated knowledge, in the following areas:
   - Operation of the facility
   - Plant safety
   - Plant instrumentation
   - Theory of testing
   - Quality assurance requirements
4. Be certified by the OSU Program Manager.

Operators shall:

1. Be trained in, and pass a written examination, encompassing the following subject:
   - Operation of the facility
   - Plant safety
   - Plant instrumentation

   The examination shall be approved by the OSU Program Manager. This examination may be waived based on previous experience or qualifications, with documented approval of the OSU Program Manager.
2. Stand watch under the supervision of a qualified plant operator until proficient. This requirement may be waived in lieu of previous experience, with documented approval of the OSU Program Manager.
3. Be certified by the OSU Facility Operating Manager. The certification documentation shall include the following information:
   - The employer's name and organization
   - Identification of the person being qualified
   - The activities this person is qualified to perform
   - Date of the qualification
   - Period of time for which qualification is applicable
   - A description of the basis of qualification

I&C Calibration Technicians shall:

1. Pass a written examination encompassing the following subject:
   - The theory of operation of: thermocouples, RTDs, pressure detectors, differential pressure detectors, flow meters, and level detectors.
   - General calibration practices and principles as applicable to the test facailty.

   The examination shall be approved by the OSU Program Manager. This examination may be waived based on previous experience or qualifications, with documented approval of the OSU Program Manager.

5.0 TEST SPECIFICATION/TEST PROCEDURE TRAINING

Prior to testing, a pre-test brief shall be held to familiarize all personnel directly involved with the testing (e.g. test engineers, operators, and support personnel) with the test specification and applicable test procedures. This briefing shall be documented in the test log.

6.0 TRAINING RECORDS

Individual training records for personnel shall be maintained by the OSU Program Manager. These shall consist of the following records as applicable:

- Personnel records of previous work experience
- Personnel training/qualification records
- Quality Program indoctrination documentation

7.0 DRAWINGS

P & ID's (piping and instrumentation drawings), Piping As–Built Drawings (the actual piping installation drawings), applicable Vendor Fabrication drawings (tanks, vessels etc.) along with the Logic Drawing shall be used to document the physical configuration of the Test Facility. Any permanent modifications to the facility will require these drawing to be revised and approved by the Project Manager or Designee. Temporary modifications to the facility shall be documented in the applicable Test Procedure per Section 11.

8.0 INSTRUMENTATION AND INSPECTION/TEST EQUIPMENT & CALIBRATION

The procurement of calibration services shall be from a vendor that provides calibration services traceable to NIST standards. The calibration certificate should include:

1. Identification by manufacturer, model number, description, date last calibrated, and date calibration is due for the appropriate NIST traceable standard employed.
2. As-found and as-left data for all instrument functions and ranges.
3. Minimum 3 point calibration for all instrument functions and ranges or as required by the manufacturer's calibration procedure.
4. Any out-of-calibration conditions found.
5. Calibration procedure number, title, and date used for calibration.

The acceptability of calibration documentation shall be confirmed in accordance with Section 12.

9.0 INSTRUCTIONS AND PROCEDURES

Activities affecting quality shall be performed in accordance with documented instructions or procedures. Instructions and procedures shall be prepared in accordance with Section 10.0. The following procedures fall within the purview of this section:

- Calibration
- Operating
- Test administration
- Matrix Testing

10.0 DOCUMENT CONTROL

The preparation, review, approval, and use of documents that are used for instrument calibration and the attainment of test data shall be controlled. Changes to these documents shall be approved by the OSU Program Manager or Designee.

11.0 TEST CONTROL

11.1 Test Procedure Definition

Any testing defined by contract obligations shall be considered a Matrix Test and fall within the guidelines detailed below in Sections 11.2 through 11.5. All other testing shall fall within the requirements outlined in Section 11.6 below for Bench Tests. Bench Tests are those tests not requiring the use of a large test facility to explore local phenomena or instrumentation. Bench Tests are typically performed by Graduate Research Assistants in support of individual thesis topics.

11.2 Matrix Testing

Matrix Testing shall be performed in accordance with a written Matrix Test Procedure(s). The Matrix Test Procedure(s) shall be written to comply with the latest revision of the Test Specification or contract at time of testing. The Test Engineer performing the test shall sign and date each page of the test procedure when actions required by the procedure arte performed.

Changes to the Test Specification may be made with OSU concurrence as long as the proposed change is within the work scope of the contract. The Project Sponsor shall indicated the change in Test Specification by either of the following means:

1. Reviewing and signing the applicable Matrix Test Procedure to indicate acceptance of the Matrix Test as executed.

2. Indicating in writing that the Test Procedure meets the project Sponsor's test criteria.

3. Issue a revised Test Specification that reflects the Matrix test procedure as executed.

11.3 Deviations from the Test Procedure

In the case of minor changes (e.g. nomenclature) the Test Engineer may approve deviation by initialing a change to the procedure. This deviation and approval shall be documented in the test records.

For major changes, the deviation shall be submitted to the OSU Program Manager for disposition. The submittal of deviations shall be documented unless verbal notification is used.

In cases where accelerated disposition is required, the Test Engineer may verbally notify the OSU Program Manager. This verbal notification shall be documented in the test facility log (see below). The entry shall indicate: the date, a description of the deviation and the disposition, and the test group personnel making the entry. The test log entry shall also include the approval of the responsible Test Engineer. The OSU Program Manager shall document a disposition for the deviation.

11.4 Test Records

The test records shall include, but are not necessarily limited to, the following documents where applicable:

1. The test procedure used, including any minor revisions approved by the responsible Test Engineer.

2. Signed off checklists (if applicable).
3. Data collection sheets.
4. A copy of the test log.
5. Paper or electronic media containing the test data.

11.5 Test Log

A log of testing activities shall be established and maintained during matrix testing. This log shall include pertinent observations and information not contained in other records. The beginning entry shall identify personnel conducting the test and state that a pretest briefing was conducted. At the beginning of each day the date and time will be identified and further entries for that day will be identified by the time.

Changes to the test log entries shall be performed by the following method:

1. Strike out the entry to be changed with one line, so that the old entry can still be read.
2. Enter the revised information.
3. Initial and date the change.

11.6 Bench Test

Bench Tests shall be performed in accordance with a written Test Procedure(s). Bench Test Procedures shall be reviewed by the Facility Operating Manager and approved by the Major Professor. The person performing the test shall sign and date each page of the when actions required by the bench test procedure are performed.

11.7 Deviations from the Bench Test Procedure

In the case of minor changes (e.g. nomenclature) the responsible person may approve the deviation by initialing a change to the procedure. This deviation and approval shall be documented in the test records.

For major changes, the deviation shall be submitted to the Facility Operating Manager for disposition. The submittal of deviations shall be documented in accordance unless verbal notification is used.

11.8 Bench Test Records

The test records shall include, but are not necessarily limited to, the following documents where applicable:

1. The bench test procedure used, including any minor revisions approved by the responsible party.
2. Signed off checklists (if applicable).
3. Data collection sheets.
4. A copy of the test log.
5. Paper or electronic media containing the test data.

11.9 Bench Test Log

A log of testing activities shall be established and maintained during testing. This log shall include pertinent observations and information not included in other test records. Each day's entries shall identify the date, procedure and revision, personnel running the test, and personnel making entries.

Changes to the test log entries shall be performed by the following method:

1. Strike out the entry to be changed with one line, so that the old entry can still be read.
2. Enter the revised information.
3. Initial and date the change.

12.0 CALIBRATION

Test facility instrumentation used for the collection of test data, and test equipment used to calibrate this instrumentation shall be calibrated to recognized national standards. If no national standards exist, the basis of the calibration shall be documented.

Calibration shall be performed in accordance with a written procedure. The written procedure may be a manufacture-supplied document. The Facility Operating Manager shall approve calibration procedures.

Calibration documents shall be reviewed by the Facility Operating Manager during test surveillance as required.

13.0 RECORDS

Quality records for the APEX Test Facility are defined as follows:

- Piping and instrumentation drawings (P&ID's),
- Piping As-Built drawings
- Vendor Fabrication drawings
- Logic drawings
- Test Procedures
- Test Logs
- Instrument Calibration Procedures
- Scaling Report
- Quality related correspondence, transmittal and approval documentation

The following OSU records are related to facility operation, construction, permits, maintenance and safety and are not considered to be quality record.

- Construction Turnover Packages
- State and Local Permits
- Operations and Maintenance Manuals
- Emergency Procedures
- OSHA and Oregon State Safety requirements
- ASME code documentation
- Operating Procedures
- Personnel Training and Qualification Records

OSU shall make these records available to the Project Sponsor. However, formatting or content requirements for these documents shall be at the discretion of the OSU Program Manager. Records required by the QP to ensure personnel or facility safety or safeguard the integrity of Project *Sponsor's* investment, beyond those prescribed by the State of Oregon in the normal conduct of business (e.g. OSHA, ASME, and State of Oregon codes) shall be the responsibility of the Project Sponsor or as established through contract with OSU.

Quality records shall be kept in a dedicated file area at the test facility. Access to these files shall be controlled by the Project Administrative Assistant. A complete set of quality records will be transferred to the Project Sponsor upon request. Quality records specific to the project sponsor's test matrix (i.e. test procedures, test logs, scaling report, etc.) shall be maintained as quality records for 180 days following completion of matrix testing.

14.0 COMPUTER SOFTWARE CONTROL

Computer software used to collect, reduce, or analyze matrix test data shall be controlled in accordance with this section. Other software shall be controlled to a degree commensurate with its importance.

14.1 Definitions

Single Application Program - An original computer program, or specially created version of an existing configured program, used on a one time basis for a specific activity.

Responsible Engineer - The individual responsible for the development and/or validation of computer software.

14.2 Approval of Software

Computer software shall be approved for use by the OSU Program Manager following completion of validation and prior to its use in quality related activities, with the following exception:

- When computer software is a single application (e.g. spreadsheet), and the validation is documented as an integral part of the end use application, OSU Program Manager approval of the application (e.g. calculation) shall be sufficient.
- Approval of software shall be documented by the OSU Program Manager's signature on the validation package.
- All changes to the software shall be controlled and approved in the same manner as the original issue.

14.3 Vendor Supplied Software

NOTE: This procedure does not apply to general utility programs that provide sufficient output to allow for independent verification without reference to the generating program (e.g., word processors, Mathcad, etc.). Also excluded is external software that is validated through the development of specific applications, such as operating systems, compilers, and database management systems. Such general utility external software does not need to be validated.

14.3.1 Procedure

The responsible engineer shall:

1. Acquire the software from external organization. If modifications are to be performed, they shall be performed.
2. Review of the computer software and the accompanying documentation (e.g. user manual) for completeness and correctness. Assign a version number if required.
3. Identify and document the required functional requirements (i.e., the functions that the software will be required to perform).
4. Define and document a sufficient number of test cases to validate all of the functional requirements.
5. Perform the validation by running the test cases and comparing the output with alternate data secure from one of the following sources:

    - Hand calculations
    - Alternate verified calculation-based methods
    - Results of other verified programs
    - Results obtained from experiments and tests
    - Known solutions for similar or standard problems
    - Measured and documented plant data
    - Confirmed published data and correlations
    - Comparisons to known inputs and outputs (for data acquisition software)

6. Prepare a validation package. It shall identify the following information:

    - Program name and version
    - Hardware and software environment
    - Complete description of the state of user defined setup parameters.
    - Description of, or reference to, the functional requirements
    - Description of test cases
    - Evaluation of the test results
    - Reference to the applicable user's documentation
    - List of any errors encountered

7. When all errors have been resolved, sign and date the validation package.

8. Secure approval of the software in accordance with Section 14.2.

9. Provide software to the configuration control contact in accordance with this section.

10. Ensure that all released programs have been tested on the operation system of the machine on which the program is to be installed. Installation testing shall be required

when a program is installed on an operating system other than the one on which the program was originally developed or when there is a major revision to the operating system the program currently runs on. The results of the installation testing shall be documented and as a minimum shall include:

- Program name and version
- Platform installed on
- Date of test
- Individual conducting the test
- Evaluation of acceptability

NOTE: This testing is not required to be as extensive as the complete program validation, but simply an execution of a least one test problem to confirm that the installation or change process has not affected the accuracy of the program.

14.4 Software Development

In-house software for collecting, analyzing, or reducing the test data shall be developed in accordance with this section.

14.4.1 Procedure

The responsible engineer shall:

1. Document the following information:
   - Purpose of the program
   - Functional requirements for the program (i.e., the functions that the software will be required to perform)
   - Intended hardware platform
   - Operating environment
   - Development environment
2. Write the software in accordance with the above defined requirements.
3. Provide user documentation (instructions) which shall include:
   - List of execution instructions and/or command line options.
   - Definition of input instructions.
   - Description of the program output.

- List of known problems which have not been corrected.

4. Define and document a sufficient number of test cases to validate all of the functional requirements.

5. Perform the validation by running the test cases and comparing the output with alternate data secured from one of the following sources:

   - Hand calculations
   - Alternate verified calculation-based methods
   - Results of other verified programs
   - Results obtained from experiments and tests
   - Known solutions for similar or standard problems
   - Measured and documented plant data
   - Confirmed published data and correlations
   - Comparisons to known inputs and output (for data acquisition software)

6. Prepare a validation package. It shall identify the following information:

   - Program name and version
   - Location of the software, including reference to a uniquely identified source listing
   - Hardware and software environment under which the validation was run
   - Description of, or reference to, the functional requirements
   - Description of test cases
   - Evaluation of the test results
   - Reference to the applicable user's documentation
   - List of any errors encountered

7. When all errors have been corrected, sign and date the validation package.

8. Secure approval of the software in accordance with Section 14.2.

9. Provide the software to the configuration control contact in accordance with Section 14.5. (If the program is a single application, configuration control shall not be required.)

10. Ensure that all release programs have been tested on the operating system of the machine on which the program is to be installed. Installation testing shall be required when a program is installed on an operating system other than the one on which the program originally developed or when there is a major revision to the operating system the program currently runs on. This testing shall meet the criteria identified in Section 14.5.

14.5 Configuration Control

14.5.1 Configuration Control Contact

The configuration control contact shall be the individual responsible for configuration control of computer software. The configuration control contact shall be designated by the OSU Program Manager.

NOTE: Configuration control of vendor supplied software may be limited to user selectable parameter, such as setup and configuration, if applicable.

14.5.2 Responsibility

The responsible engineer shall be responsible for:

- Providing the required information to the configuration control contact.

The configuration control contact shall be responsible for:

- Controlling access to the source code
- Providing the program to users as directed by the responsible engineer.

14.5.3 Procedure - Original Version

The responsible engineer shall:

1. Develop and validate the computer software in accordance with Section 14.5 and Section 14.6.

2. Assign a name and version number to the software is none exists.

3. Provide the source code (if available), DAS configuration (if applicable), file executable code (if compiled), validation documentation, and user documentation to the configuration control contact.

The configuration control contact shall:

1. Ensure that the software has been completed, validated and approved as required.

2. Ensure that the source code is placed in a secure, access controlled location, or is otherwise secured from tampering. (An access controlled location may be a physical location or in an access control [e.g. password] directory.)

3. Install the program in the location to be used as directed by the responsible engineer (executable and/or object code only).

NOTE: Access to the source code and DAS configuration file shall be limited to the configuration control contact. No other personnel shall be permitted access to the source code, except as hard copy, unless approved by the OSU Program Manager.

14.5.4 Procedure 2 - Program Revisions

The responsible engineer shall:

- Request that the configuration control contact release the source code for modification.

The configuration control contact shall:

- Provide a copy of the source code to the responsible engineer, and retain a copy of the existing version.

The responsible engineer shall:

- Follow Section 14.4 to revise the code.
- Upon successful validation of the revised code, the new version shall be formally released for use and archived according to Section 14.5. A text-based release file (readme.txt or similar) shall be part of the installation and made available to end-users to review the changes.

OREGON STATE UNIVERSITY

DEPARTMENT OF NUCLEAR ENGINEERING

ADVANCED THERMAL HYDRAULIC RESEARCH LABORATORY

OSU-D-03

APEX AP1000 CRITICAL INSTRUMENT CHANNEL VALIDATION

Revision 0

John Groome, Originator — Date
Facility Operating Manager
Research Associate

José N. Reyes, Jr. — Date
OSU Program Manager Approval

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APPENDIX A

1.0 OBJECTIVES

The objective of this procedure is to perform a hot functional check and critical instrument channel validation of the Data Acquisition System (DAS) upgrade. The critical instruments are those channels identified by Westinghouse Electric Corporation as the minimum/critical channels required to perform post-test data analysis for the DEDVI test as being conducted under DOE Contract: DE-FG03-01SF22326.

To perform the critical instrument channel validation, a known signal will be injected at the appropriate field I/O junction box, or in the case of transmitters at the instrument. The channel response will be verified on the DAS computer user interface and in the data log file. Additionally, the test facility will be operated at NOP/NOT conditions to verify proper indication at initial test conditions.

2.0 REFERENCES

2.1 The following OSU P&IDs are referenced:

OSU 600LEG	Sheet 1 of 2	Rev 6
OSU 600LEG	Sheet 2 of 2	Rev 7
OSU 600002	Sheet 1 of 2	Rev 11
OSU 600002	Sheet 2 of 2	Rev 43
OSU 600007	Sheet 1 of 1	Rev 4
OSU 600008	Sheet 1 of 2	Rev 4
OSU 600101	Sheet 1 of 2	Rev 6
OSU 600101	Sheet 2 of 2	Rev 4
OSU 600203	Sheet 1 of 1	Rev 11
OSU 600206	Sheet 1 of 1	Rev 10
OSU 600301	Sheet 1 of 1	Rev 10
OSU 600501	Sheet 1 of 1	Rev 6
OSU 600502	Sheet 1 of 1	Rev 6
OSU 600701	Sheet 1 of 1	Rev 8
OSU 600901	Sheet 1 of 1	Rev 6
OSU 600902	Sheet 1 of 1	Rev 3
OSU 600903	Sheet 1 of 1	Rev 3
OSU 600904	Sheet 1 of 1	Rev 1

2.2 The following OSU/APEX Test Facility Logic Drawings:

OSU 500800	Sheet 1 of 3	Rev 0
OSU 500801	Sheet 1 of 20	Rev 6
OSU 500801	Sheet 2 of 20	Rev 4
OSU 500801	Sheet 3 of 20	Rev 5
OSU 500801	Sheet 4 of 20	Rev 6.1
OSU 500801	Sheet 5 of 20	Rev 6
OSU 500801	Sheet 6 of 20	Rev 4
OSU 500801	Sheet 7 of 20	Rev 5
OSU 500801	Sheet 8 of 20	Rev 6
OSU 500801	Sheet 9 of 20	Rev 6
OSU 500801	Sheet 10 of 20	Rev 5
OSU 500801	Sheet 11 of 20	Rev 5
OSU 500801	Sheet 12 of 20	Rev 4
OSU 500801	Sheet 13 of 20	Rev 6
OSU 500801	Sheet 14 of 20	Rev 6
OSU 500801	Sheet 15 of 20	Rev 6.1
OSU 500801	Sheet 16 of 20	Rev 6.1

OSU 500801	Sheet 17 of 20	Rev 6
OSU 500801	Sheet 18 of 20	Rev 6
OSU 500801	Sheet 19 of 20	Rev 6
OSU 500801	Sheet 20 of 20	Rev 5

2.3 Setpoint Document, OSU-E-02, OSU-APEX-94010, Revision 2.

2.4 Administrative Procedure A-05, Testing Administration, Revision 1.

2.5 ATHRL Quality Plan, Revision 2.

2.6 ATHRL Maintenance and Operations Procedures Manual

3.0 PREREQUISITES

STEP 3.1 ☑ Verify all critical instruments are installed and wiring to DAS is complete.

STEP 3.2 ☑ Verify DAS is operational and available to log data channels.

STEP 3.3 ☑ Perform pre-test brief.

4.0 THERMOCOUPLE CHANNEL VALIDATION CHECK

NOTE: To verify that the critical thermocouple channels have been properly wired and configured to the DAS, a millivolt (mV) signal will be inserted at the first field I/O junction that the associated thermocouple under test leads are landed on. To insert a signal, source test leads will be momentarily placed on the appropriate terminations and the DAS operator will verify and record the DAS computer reading.

STEP 4.1 ☑ Obtain a Tegam 840A or equivalent thermocouple simulator.

STEP 4.2 ☑ Configure the DAS to log all critical instrument thermocouple channels at a minimum scan rate of 1 second.

STEP 4.3 ☑ Start the DAS logger.

STEP 4.4 ☑ Record initial ambient temperature on Appendix A as read on the DAS computer.

STEP 4.5 ☑ Set the thermocouple simulator to simulate a Type K thermocouple at 400°F.

STEP 4.6 ☑ For each thermocouple listed on Appendix A; disconnect the thermocouple leads and place the thermocouple simulator test leads (yellow +; red -) on the field I/O termination point and record DAS computer reading on Appendix A.

STEP 4.7 ☑ Secure the DAS logger and export data to the tab deliminated text file:

Data File Name: DASTC_VAL.TXT

STEP 4.8 ☑ Record results/discrepancies on Appendix A.

5.0 TRANSMITTER CHANNEL VALIDATION CHECK

NOTE To verify that the critical transmitters (pressure, flow, and signal conditioners) have been properly wired and configured to the DAS, a 0% (4 mA/1 volt), 50% (12 mA/3 volt), and 100% (20 mA/5 volt) signal will be simulated by using either:

1) Hand held communicator,
2) Instrument front panel interface, or
3) In the case of vortex flowmeter, shedding frequency.

The DAS operator will verify and record the DAS computer reading.

STEP 5.1 ☑ Configure the DAS to log all critical instrument thermocouple channels at a minimum scan rate of 1 second.

STEP 5.2 ☑ For each transmitter listed on Appendix A, refer to the "OSU Maintenance and Operations Procedures" manual and simulate a 0%, 50%, and 100% signal.

NOTE Allow each signal adequate time to stabilize before simulating the next step. Record DAS computer reading on Appendix A.

STEP 5.3 ☑ Secure the DAS logger and export data to the tab deliminated text file:

Data File Name: DAS LOOPS_VAL 1-TXT
DAS LOOPS_VAL 2-TXT

STEP 5.4 ☑ Record results/discrepancies on Appendix A.

6.0 CRITICAL CHANNEL HOT FUNCTIONAL CHECK

STEP 6.1 ☑ Configure the DAS to log all critical instrument thermocouple channels at a minimum scan rate of 1 second.

STEP 6.2 ☑ Start the DAS logger.

STEP 6.3 ☑ Perform test facility startup to normal operating temperature and pressure using APEX Operations Manual, OP-B.3 and OP-C.1.

STEP 6.4 ☑ With the test facility at NOP/NOT, ensure all critical instrument channel listed on Appendix A are reading as expected. Note any discrepancies in the test log.

STEP 6.5 ☑ Secure the DAS logger and export data to the tab deliminated text file:

Data File Name: DASHOT_FUNC_VAC.TXT

STEP 6.6 ☑ Record results/discrepancies on Appendix A.

7.0 POST-TEST ACTIVITIES

STEP 7.1 ☑ Plot all critical instrument channels and review channel plots for expected readings/response. Note any discrepancies in the test log.

8.0 ACCEPTANCE CRITERIA

STEP 8.1 ☑ Critical instruments functioned throughout the test.

STEP 8.2 ☑ All test steps were performed as written. Any deviation from the test procedures have been dispositioned and approved as required per Reference 2.4.

ACCEPTANCE CRITERIA MET

John Groome	John Groome	2/15/03
Test Engineer Name	Test Engineer Signature	Date

TEST LOG

Procedure Number: OSU-D-03 Rev.: 6

Test Engineer: DAN Groone Date: 1/31/03

Time	Comments
1515	Conducted Pretest Brief w/ T Culver, & Dave Gray (TIC) & J Hopson.
1528	STARTED DAS TC VALIDATION Sect 4.0
1702	completed DAS TC VALIDATION - NO Further Entries this day JHG
1530	2/3/03 STARTED DAS LOOP VALIDATION Sect 5.0
1800	SECURED DAS LOOP VALIDATION - NO further entries this day JHG
1500	2/4/03 continued DAS LOOP VALIDATION Sect 5.0
1731	completed DAS LOOP VALIDATION Sect 5.0 - NO further ENTRIES this date JHG
1600	2/4/03 STARTED DAS & logged all channels for Hot Functional Validation Sect 6.0 The facility was started from ~ 200°F → 920°F @ 570 psig. A BD was performed thru the DEDVI BRK spool piece
1825	SECURED logging data channels - NO further entries this day JHG
1500	2/5/03 REVIEW OF ALL critical instrument data plots w/ Rick Wright (W) indicates all critical channels functioned properly. JHG 2/5/03

Tag	Ambient Das Reading	400°F Simulated Signal Das Reading	Criteria Met? (± 2.5°F)	Logged Data File Response? (Y/N)	Hot Functional Response? (Y/N)
TF-101	69.14	401.50	Yes	Yes	Yes
TF-102	69.71	400.83	Yes	Yes	Yes
TF-105	69.95	401.40	Yes	Yes	Yes
TF-106	69.68	400.13	Yes	Yes	Yes
TF-140	68.08	401.98	Yes	Yes	Yes
TF-141	68.70	402.40	Yes	Yes	Yes
TF-167	65.15	398.30	Yes	Yes	Yes
TF-205	68.01	401.25	Yes	Yes	Yes
TF-206	67.12	400.30	Yes	Yes	Yes
TF-301	72.20	402.34	Yes	Yes	Yes
TF-310	71.80	402.50	Yes	Yes	Yes
TF-401	64.22	398.23	Yes	Yes	Yes
TF-402	65.80	398.24	Yes	Yes	Yes
TF-405	65.40	397.44	Yes	Yes	Yes
TF-406	65.36	397.75	Yes	Yes	Yes
TF-502	66.70	398.16	Yes	Yes	Yes
TF-535	66.13	398.31	Yes	Yes	Yes
TF-549	64.16	398.31	Yes	Yes	Yes
TF-550	64.71	398.63	Yes	Yes	Yes
TF-608	67.76	400.73	Yes	Yes	Yes
TF-903	58.99	400.73	Yes	Yes	Yes

Test Engineer Signature J. L. Groome Date 2/6/03

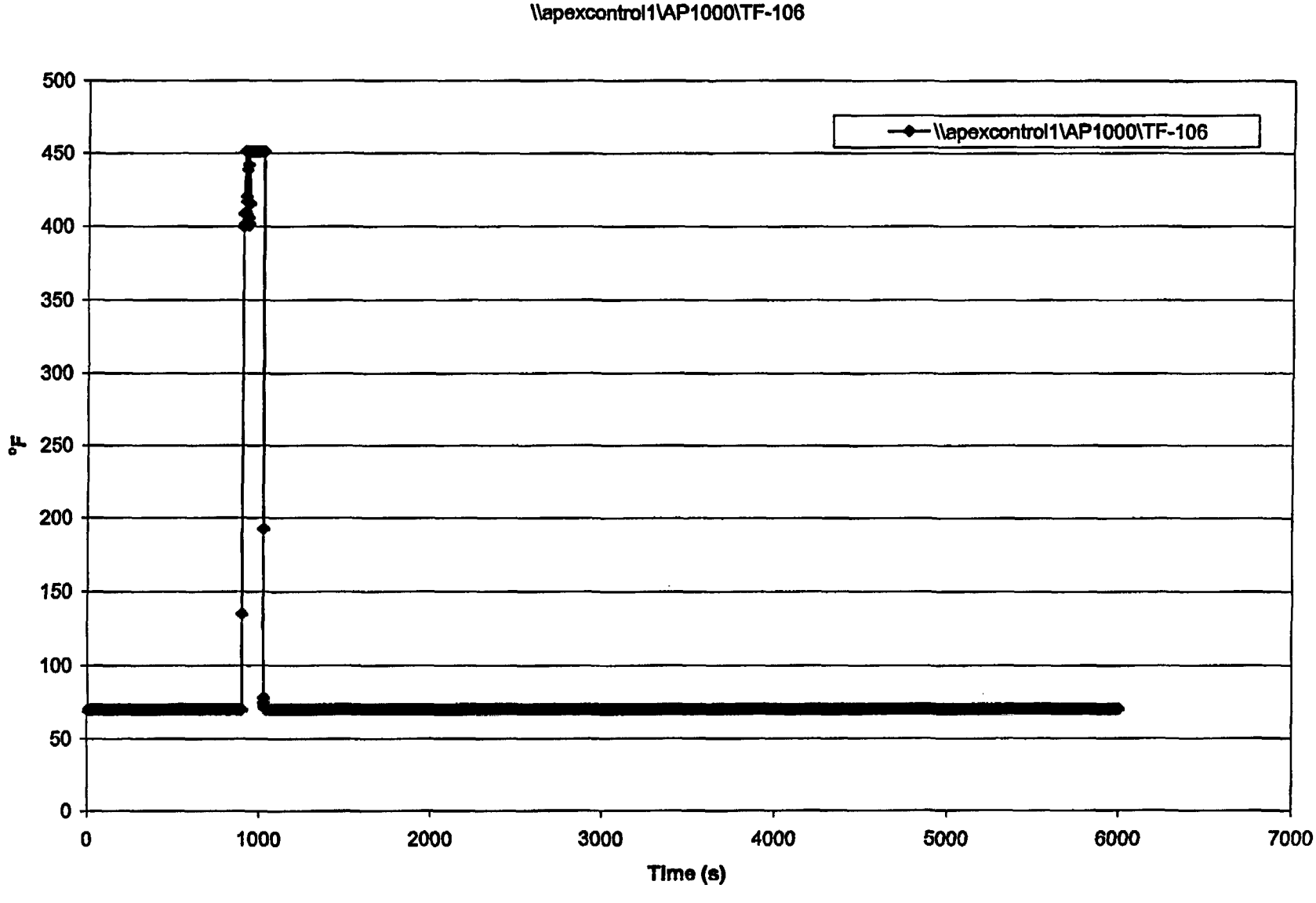
Tag	Phys Min	Phys Max	Phys Units	0%		50%		100%		Criteria (0.5%)	Criteria Met ?	Logged Data File Response? (Y/N)	Hot Functional Response?
				Desired	Das Reading	Desired	Das Reading	Desired	Das Reading				
DP-401	0	400	in H2O	0	1.04	200	201.07	400	401.07	± 2	Yes	Yes	Yes
DP-402	0	400	psi	0	0.21	200	200.26	400	400.28	± 2	Yes	Yes	Yes
DP-501	-150	150	in H2O	-150	-149.29	0	0.75	150	150.68	± 0.75	Yes	Yes	Yes
DP-502	-150	150	in H2O	-150	-149.86	0	0.19	150	150.23	± 0.75	Yes	Yes	Yes
DP-701	0	30	psi	0	0.01	15	15.01	30	30.17	± 0.15	Yes	Yes	Yes
DP-702	0	30	psi	0	0.01	15	15.02	30	30.01	± 0.15	Yes	Yes	Yes
FMM-205	0	75	GPM	0	0.04	37.5	37.48	75	75.04	± 0.375	Yes	Yes	Yes
FMM-206	0	75	GPM	0	0.02	37.5	37.47	75	75.00	± 0.375	Yes	Yes	Yes
FMM-401	0	40	GPM	0	0.02	20	20.04	40	40.02	± 0.2	Yes	Yes	Yes
FMM-402	0	40	GPM	0	0.03	20	19.99	40	40.02	± 0.2	Yes	Yes	Yes
FMM-501	0	75	GPM	0	0.04	37.5	37.41	75	75.04	± 0.375	Yes	Yes	Yes
FMM-504	0	20	GPM	0	0.01	10	10.00	20	20.01	± 0.1	Yes	Yes	Yes
FMM-601	0	200	GPM	0	0.17	100	100.47	200	200.87	± 1	Yes	Yes	Yes
FMM-602	0	60	GPM	0	0.06	30	30.10	60	60.20	± 0.3	Yes	Yes	Yes
FMM-603	0	60	GPM	0	0.06	30	30.05	60	60.12	± 0.3	Yes	Yes	Yes
FMM-701	0	40	GPM	0	0.02	20	20.01	40	40.20	± 0.2	Yes	Yes	Yes
FMM-702	0	40	GPM	0	0.02	20	20.00	40	40.02	± 0.2	Yes	Yes	Yes
FMM-901	0	100	GPM	0	0.05	50	50.01	100	100.05	± 0.5	Yes	Yes	Yes
FMM-902	0	40	GPM	0	0.02	20	20.03	40	40.01	± 0.2	Yes	Yes	Yes
FMM-905	-60	60	GPM	-60	-59.99	0	0.21	60	60.02	± 0.025	Yes	Yes	Yes
FVM-601	0	2000	cfm	0	5.92	1000	1010.00	2000	2006.80	± 10	Yes	Yes	Yes
FVM-602	0	2500	cfm	0	1.13	1250	1251.00	2500	2501.00	± 12.5	Yes	Yes	Yes
FVM-603	0	140	cfm	0	2.53	70	70.11	140	140.01	± 0.7	Yes	Yes	Yes
FVM-604	0	269	cfm	0	0.06	134.5	134.42	269	268.94	± 1.35	Yes	Yes	Yes
FVM-605	0	269	cfm	0	0.05	134.5	134.43	269	268.96	± 1.35	Yes	Yes	Yes
FVM-901	0	1600	cfm	0	4.04	800	809.60	1600	1602.00	± 80	Yes	Yes	Yes
FVM-905	0	6000	cfm	0	17.60	3000	3017.15	6000	6013.20	± 30	Yes	Yes	Yes
FVM-906	0	4000	cfm	0	15.06	2000	2016.50	4000	4020.00	± 20	Yes	Yes	Yes
KW-101	1	5	Volts	1	1.00	3	3.01	5	5.00	± 0.025	Yes	Yes	Yes
KW-102	1	5	Volts	1	1.00	3	3.06	5	5.00	± 0.025	Yes	Yes	Yes
LDP-112	0	4.696	In H2O	0	0.02	2.348	2.35	4.696	4.70	± 0.023	Yes	Yes	Yes
LDP-113	0	15.614	in H2O	0	0.01	7.807	7.81	15.614	15.62	± 0.078	Yes	Yes	Yes
LDP-115	0	24.28	in H2O	0	0.03	12.14	12.15	24.28	24.29	± 0.12	Yes	Yes	Yes
LDP-118	0	39.98	in H2O	0	0.01	19.99	20.01	39.98	40.00	± 0.2	Yes	Yes	Yes
LDP-127	0	120.04	In H2O	0	0.02	60.02	60.02	120.04	120.04	± 0.6	Yes	Yes	Yes

Test Engineer Signature  Date 2/15/03

Tag	Phys Min	Phys Max	Phys Units	0%		50%		100%		Criteria (0.5%)	Criteria Met ?	Logged Data File Response? (Y/N)	Hot Functional Response?
				Desired	Das Reading	Desired	Das Reading	Desired	Das Reading				
LDP-201	0	2.626	in H2O	0	0.00	1.313	1.32	2.626	2.63	± 0.013	Yes	Yes	Yes
LDP-202	0	4.115	in H2O	0	0.02	2.0575	2.06	4.115	4.12	± 0.021	Yes	Yes	Yes
LDP-203	0	2.644	in H2O	0	0.00	1.322	1.32	2.644	2.65	± 0.013	Yes	Yes	Yes
LDP-204	0	3.637	in H2O	0	0.00	1.8185	1.82	3.637	3.63	± 0.018	Yes	Yes	Yes
LDP-205	0	4.085	in H2O	0	0.00	2.0425	2.05	4.085	4.09	± 0.02	Yes	Yes	Yes
LDP-206	0	4.013	in H2O	0	0.00	2.0065	2.01	4.013	4.02	± 0.02	Yes	Yes	Yes
LDP-301	0	119.25	in H2O	0	0.24	59.625	59.88	119.25	119.44	± 0.596	Yes	Yes	Yes
LDP-302	0	119.02	in H2O	0	0.25	59.51	59.75	119.02	119.26	± 0.595	Yes	Yes	Yes
LDP-401	0	37.49	in H2O	0	0.07	18.745	18.82	37.49	37.56	± 0.187	Yes	Yes	Yes
LDP-402	0	38.34	in H2O	0	0.07	19.17	19.24	38.34	38.42	± 0.192	Yes	Yes	Yes
LDP-502	0	57.17	in H2O	0	0.12	28.585	28.69	57.17	52.28	± 0.286	Yes	Yes	Yes
LDP-507	0	57.5	in H2O	0	0.12	28.75	28.88	57.5	57.62	± 0.288	Yes	Yes	Yes
LDP-601	0	142.17	in H2O	0	0.02	71.085	71.08	142.17	142.18	± 0.711	Yes	Yes	Yes
LDP-609	0	14.717	in H2O	0	0.04	7.3585	7.39	14.717	14.76	± 0.074	Yes	Yes	Yes
LDP-610	0	45.79	in H2O	0	0.14	22.895	23.05	45.79	45.95	± 0.229	Yes	Yes	Yes
LDP-611	0	55.97	in H2O	0	0.15	27.985	28.15	55.97	56.14	± 0.28	Yes	Yes	Yes
LDP-612	0	56.6	in H2O	0	0.17	28.3	28.46	56.6	56.76	± 0.283	Yes	Yes	Yes
LDP-701	0	115.8	in H2O	0	0.25	57.9	58.14	115.8	116.04	± 0.579	Yes	Yes	Yes
LDP-901	0	104.36	in H2O	0	0.01	52.18	52.19	104.36	104.38	± 0.522	Yes	Yes	Yes
LDP-905	0	130.68	in H2O	0	0.36	65.34	65.71	130.68	131.08	± 0.653	Yes	Yes	Yes
PT-107	0	500	psi	0	1.05	250	251.06	500	500.98	± 2.5	Yes	Yes	Yes
PT-301	0	500	psi	0	1.03	250	250.95	500	501.02	± 2.5	Yes	Yes	Yes
PT-302	0	500	psi	0	0.04	250	250.01	500	499.96	± 2.5	Yes	Yes	Yes
PT-401	0	300	psi	0	0.13	150	150.18	300	300.17	± 1.5	Yes	Yes	Yes
PT-402	0	300	psi	0	0.15	150	150.14	300	300.11	± 1.5	Yes	Yes	Yes
PT-604	0	500	psi	0	0.07	250	249.90	500	499.89	± 2.5	Yes	Yes	Yes
PT-905	0	20	psi	0	0.06	10	9.97	20	19.88	± 0.1	Yes	Yes	Yes

Test Engineer Signature  Date 2/15/03

APEX AP1000 Critical Instrument Channel Validation



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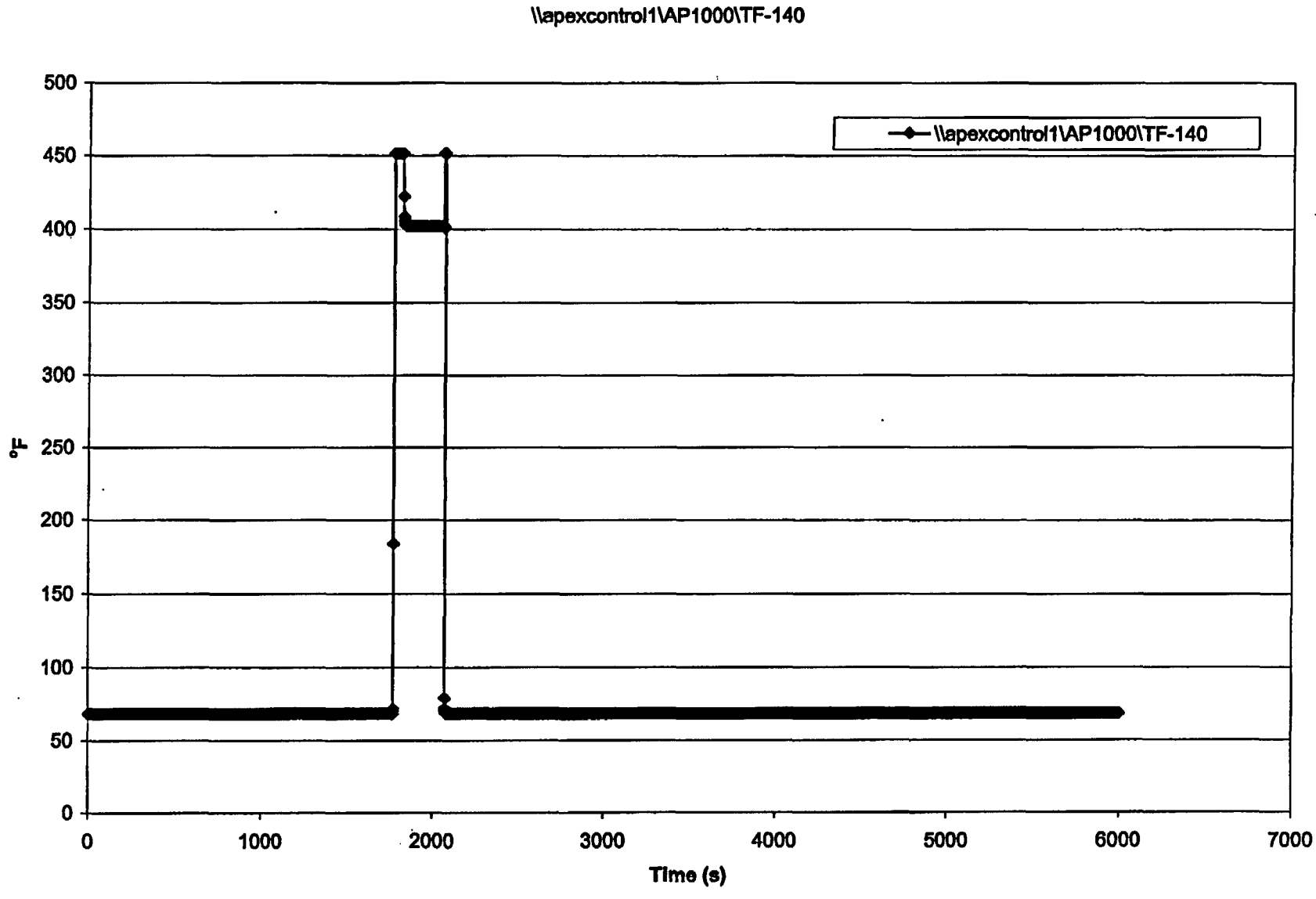

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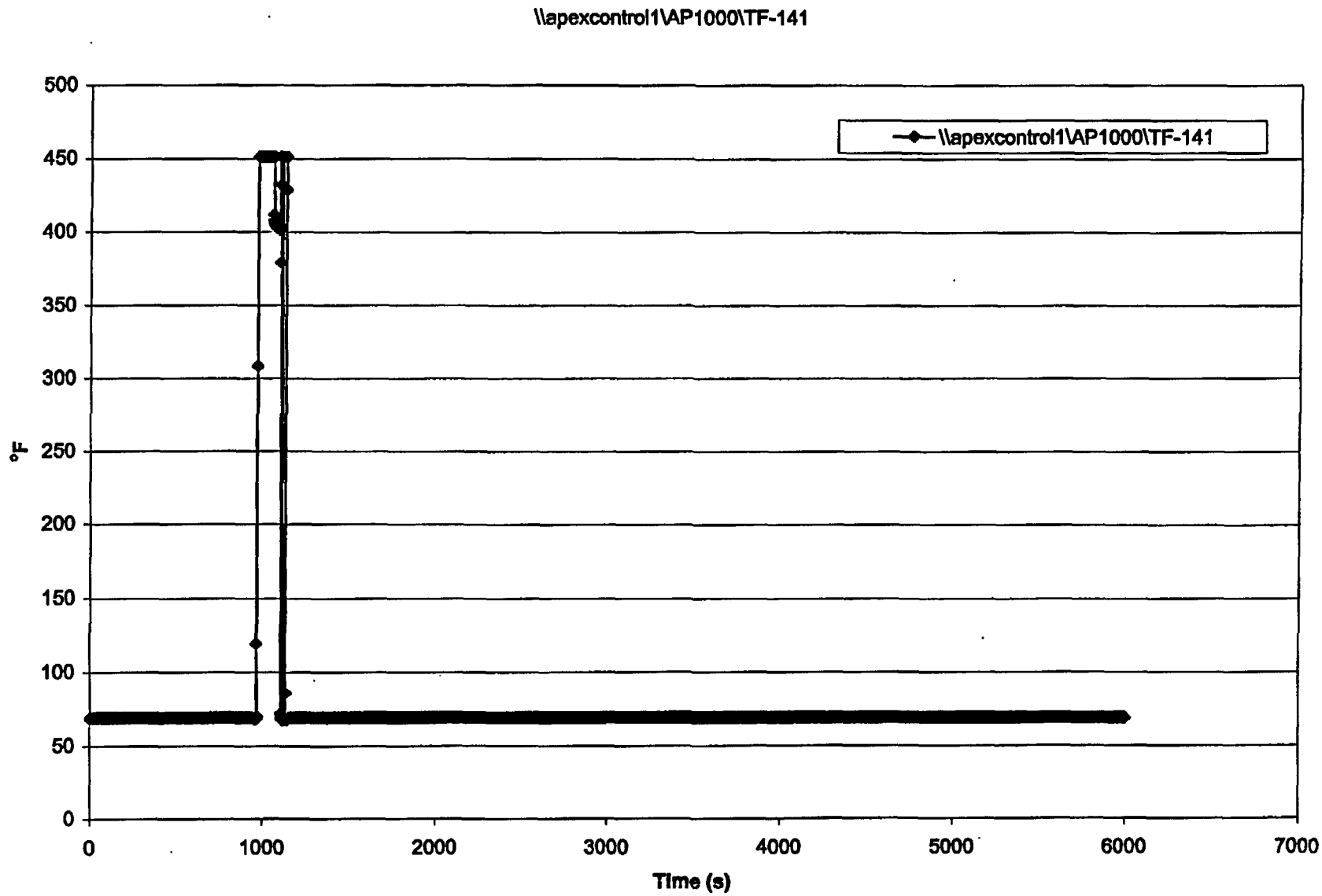

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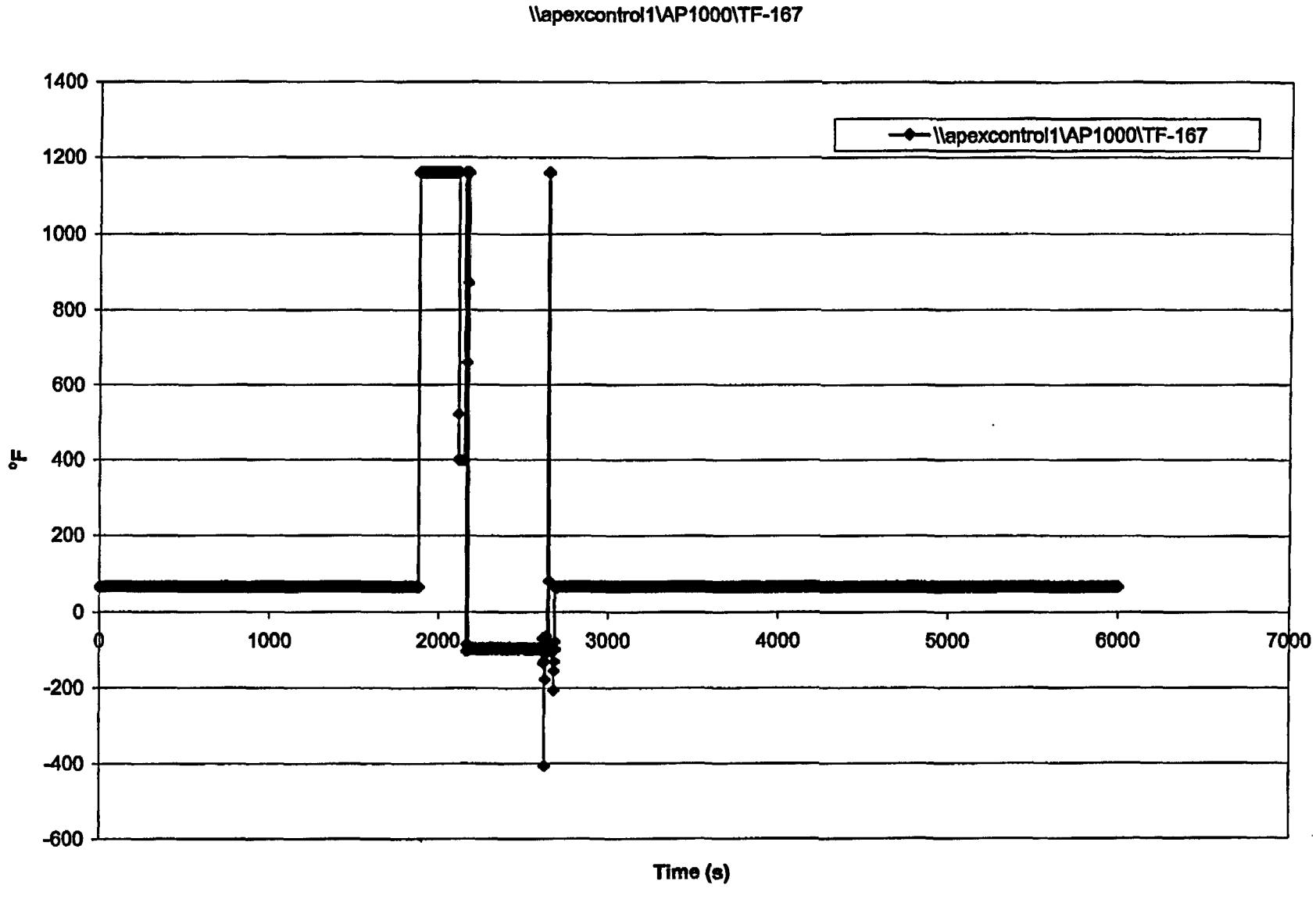

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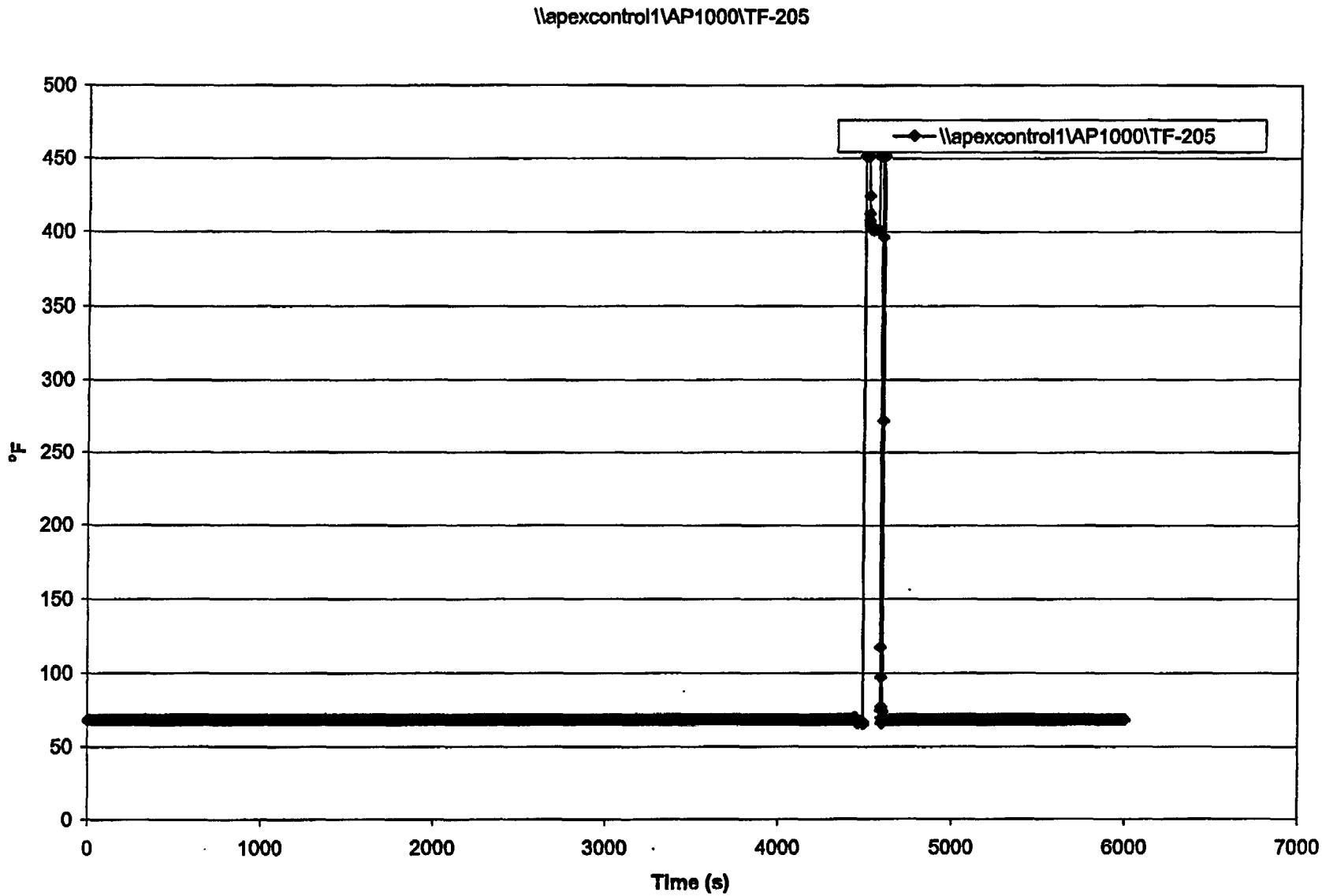

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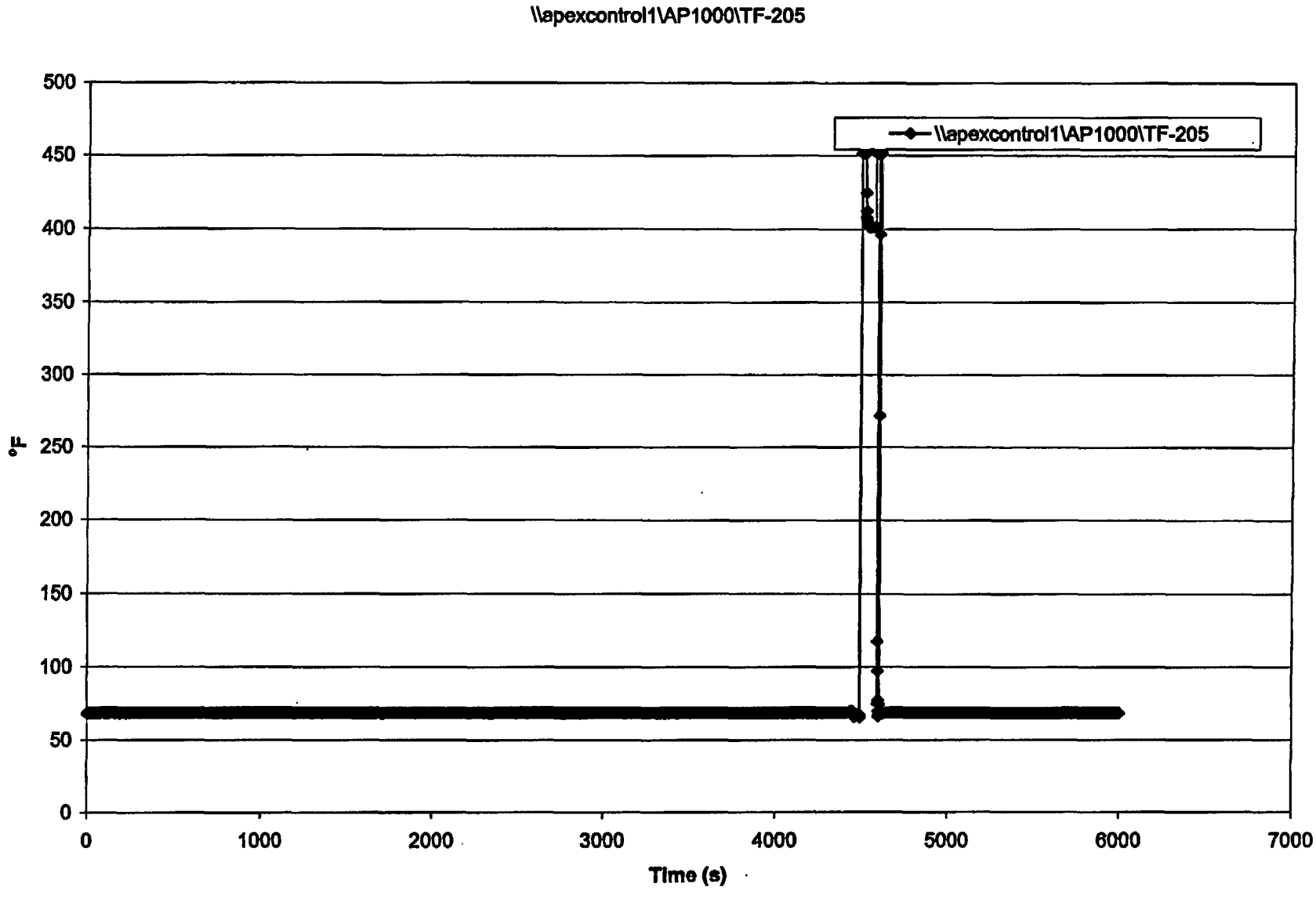

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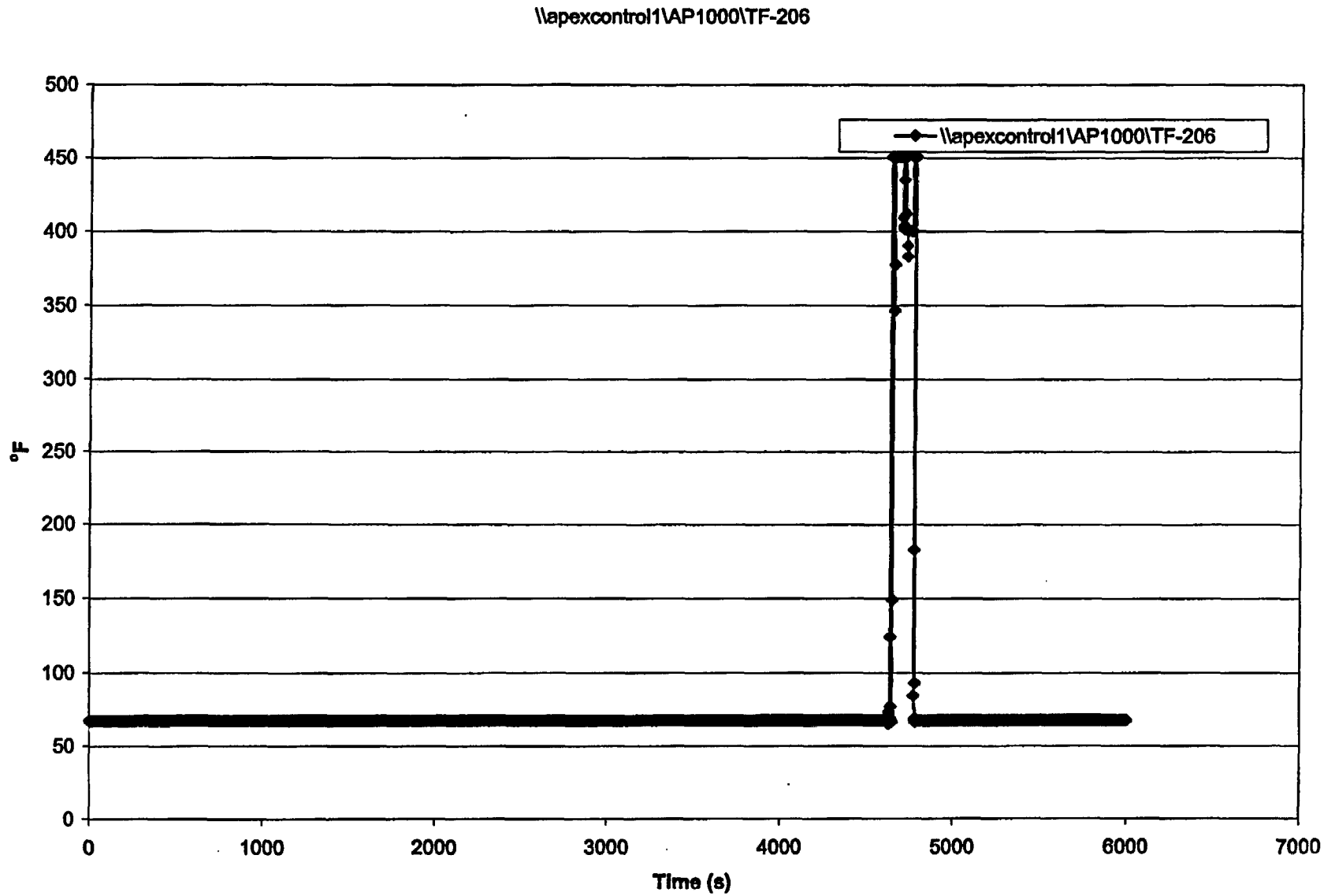

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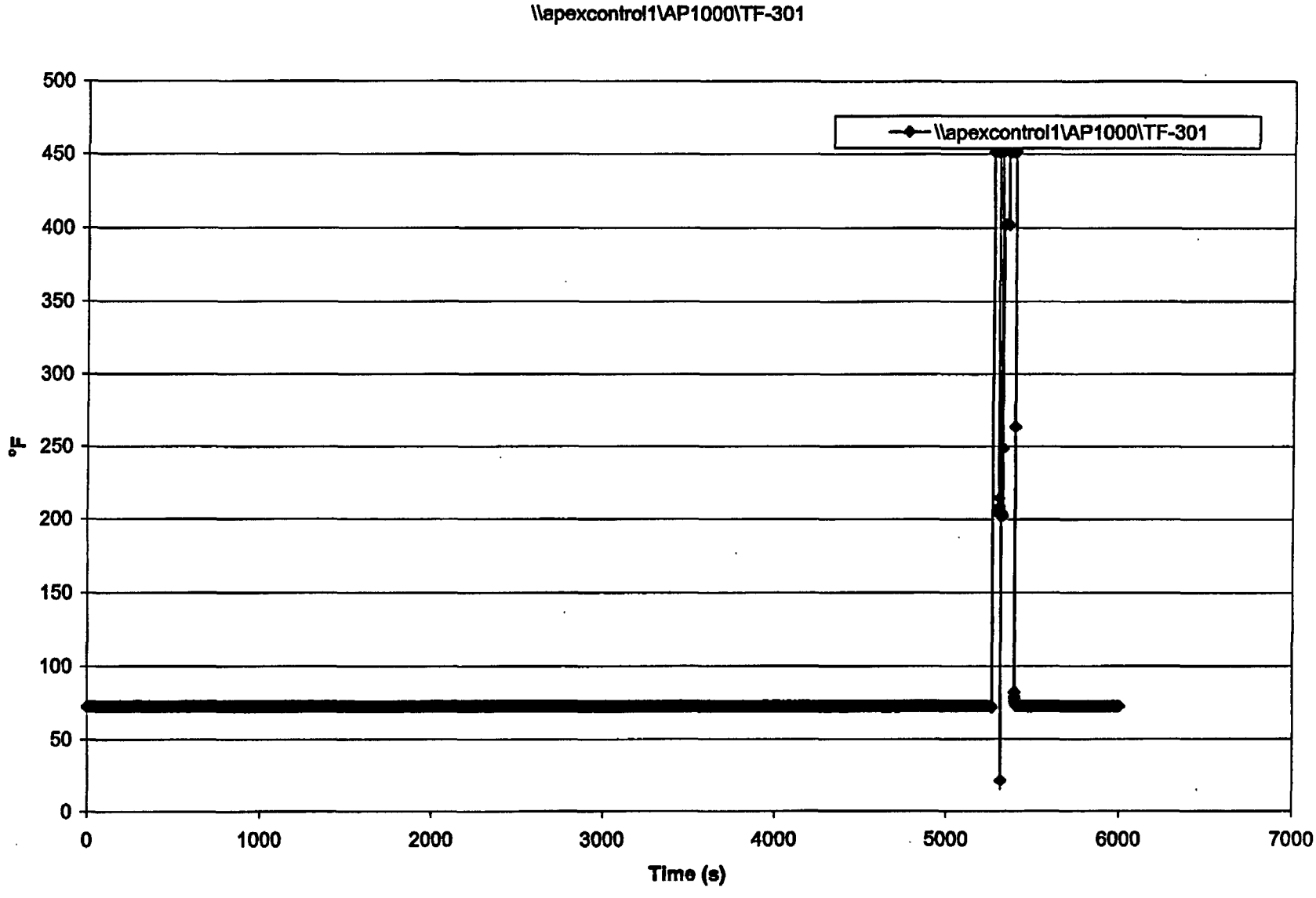

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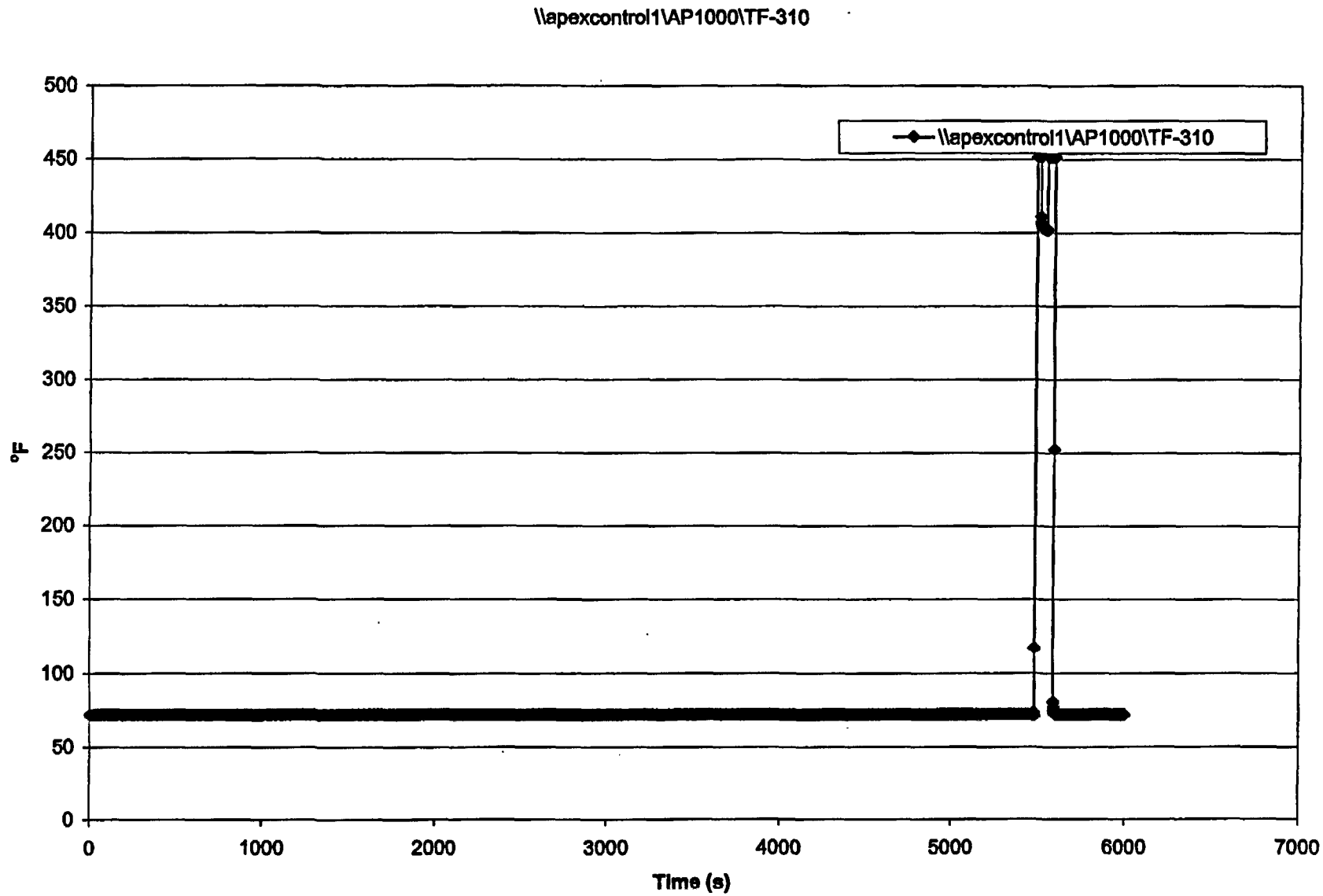

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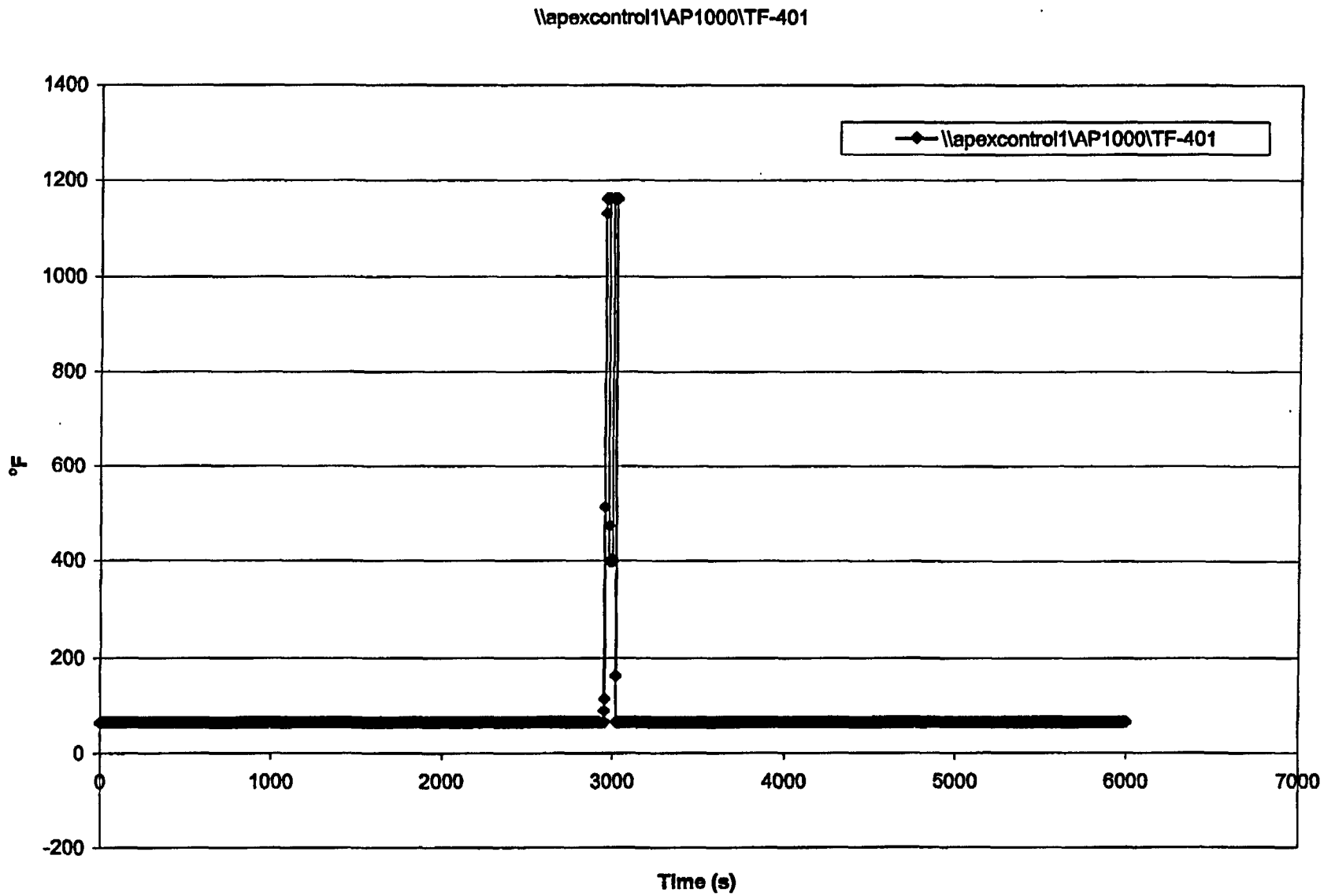

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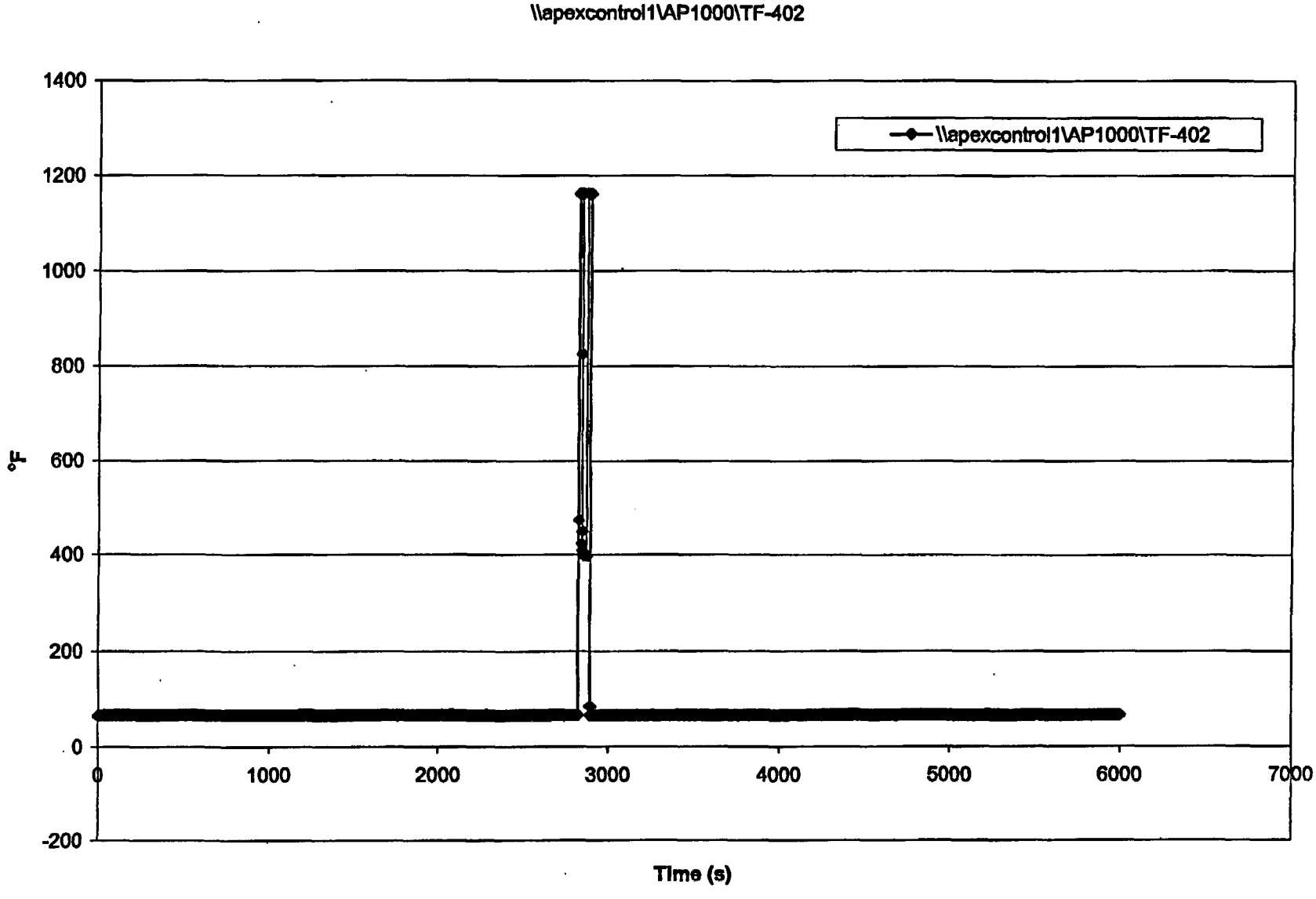

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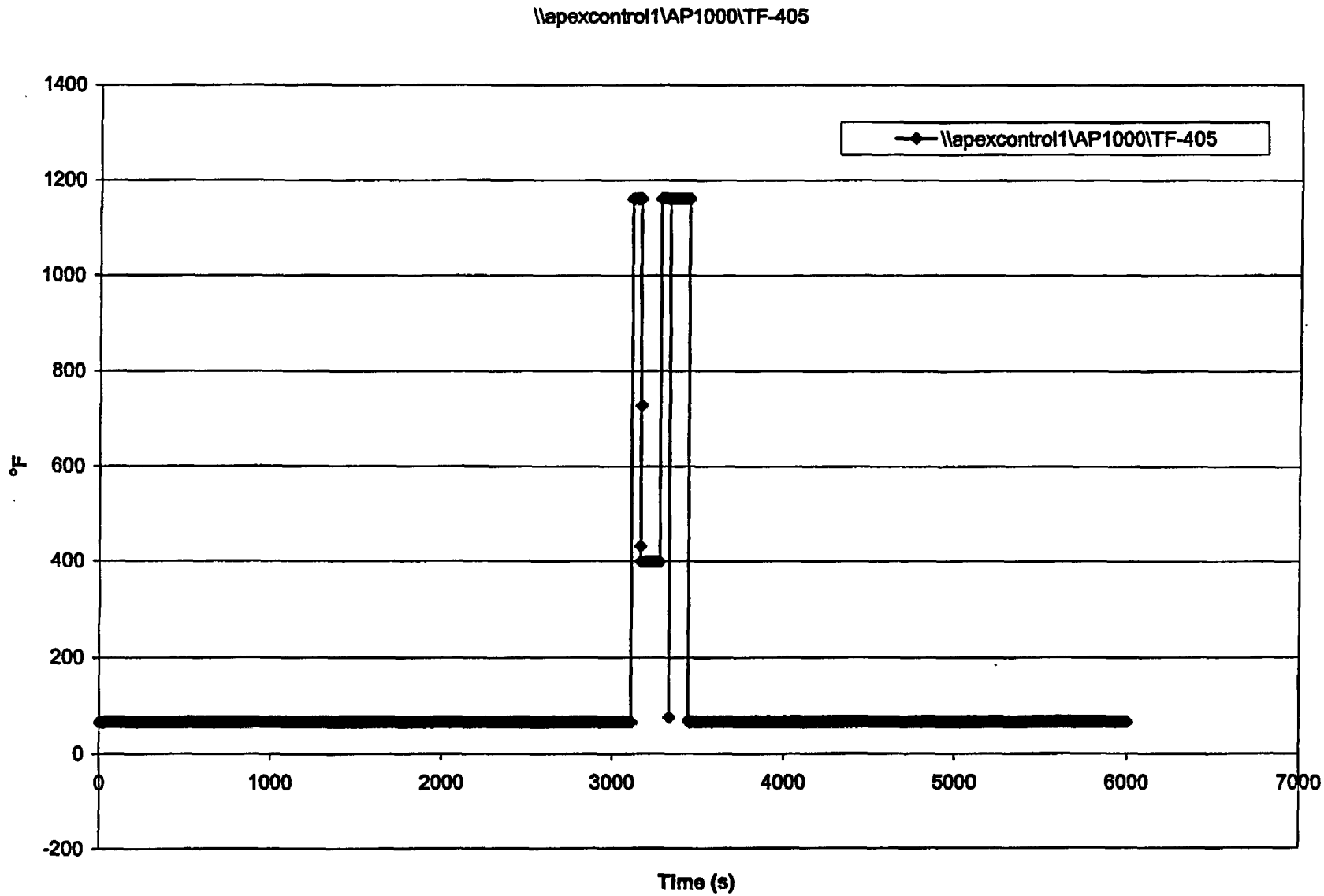

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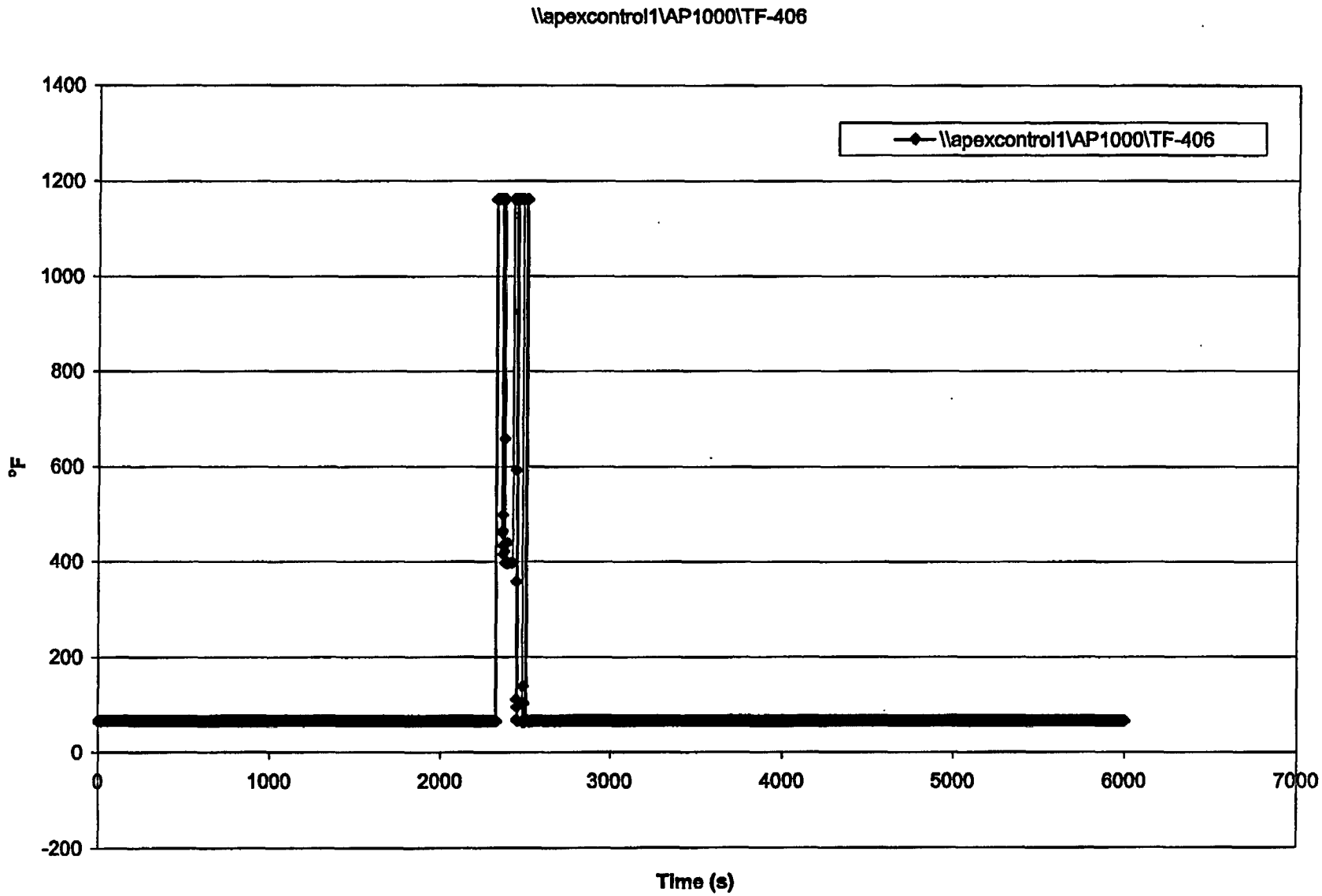

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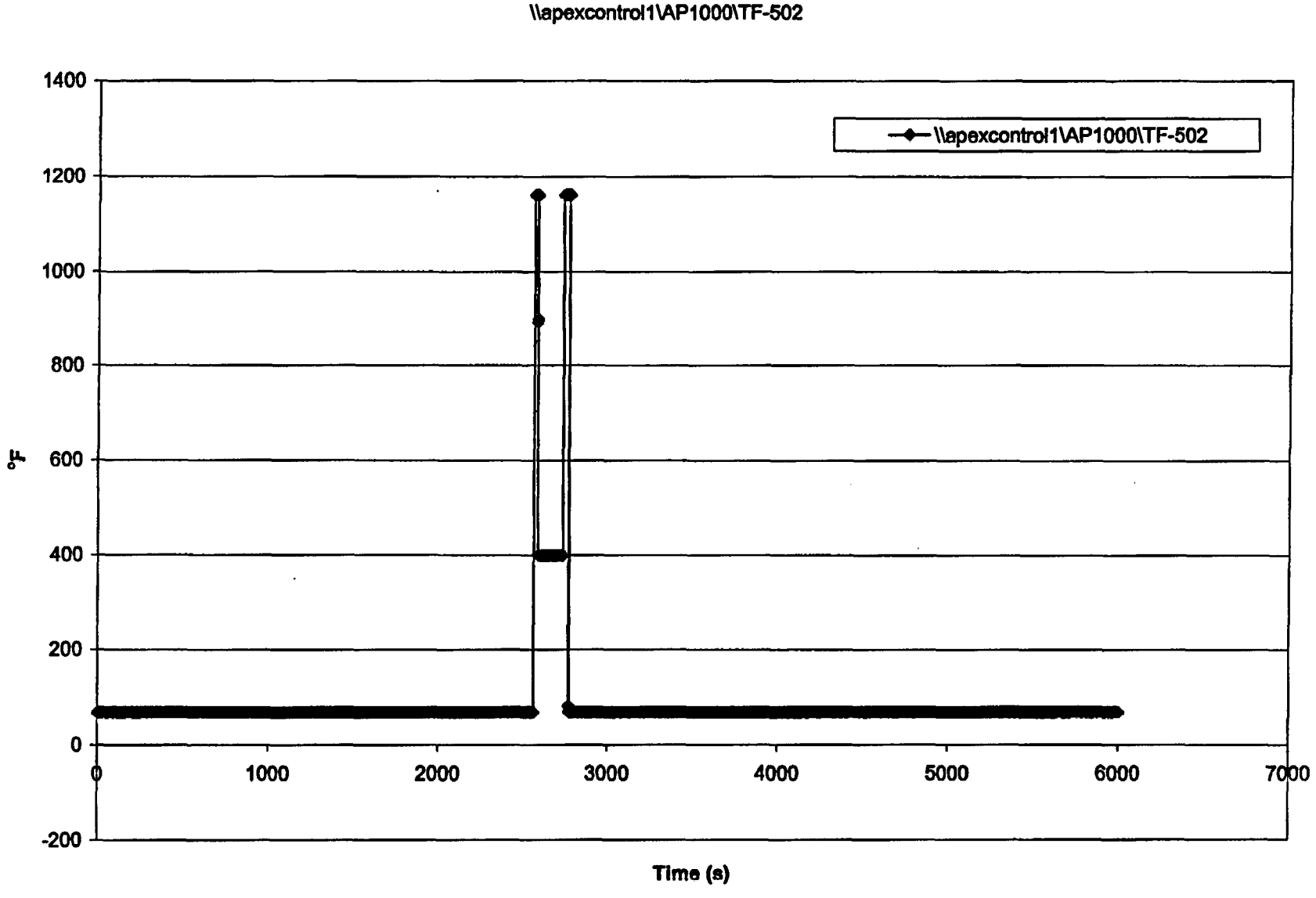

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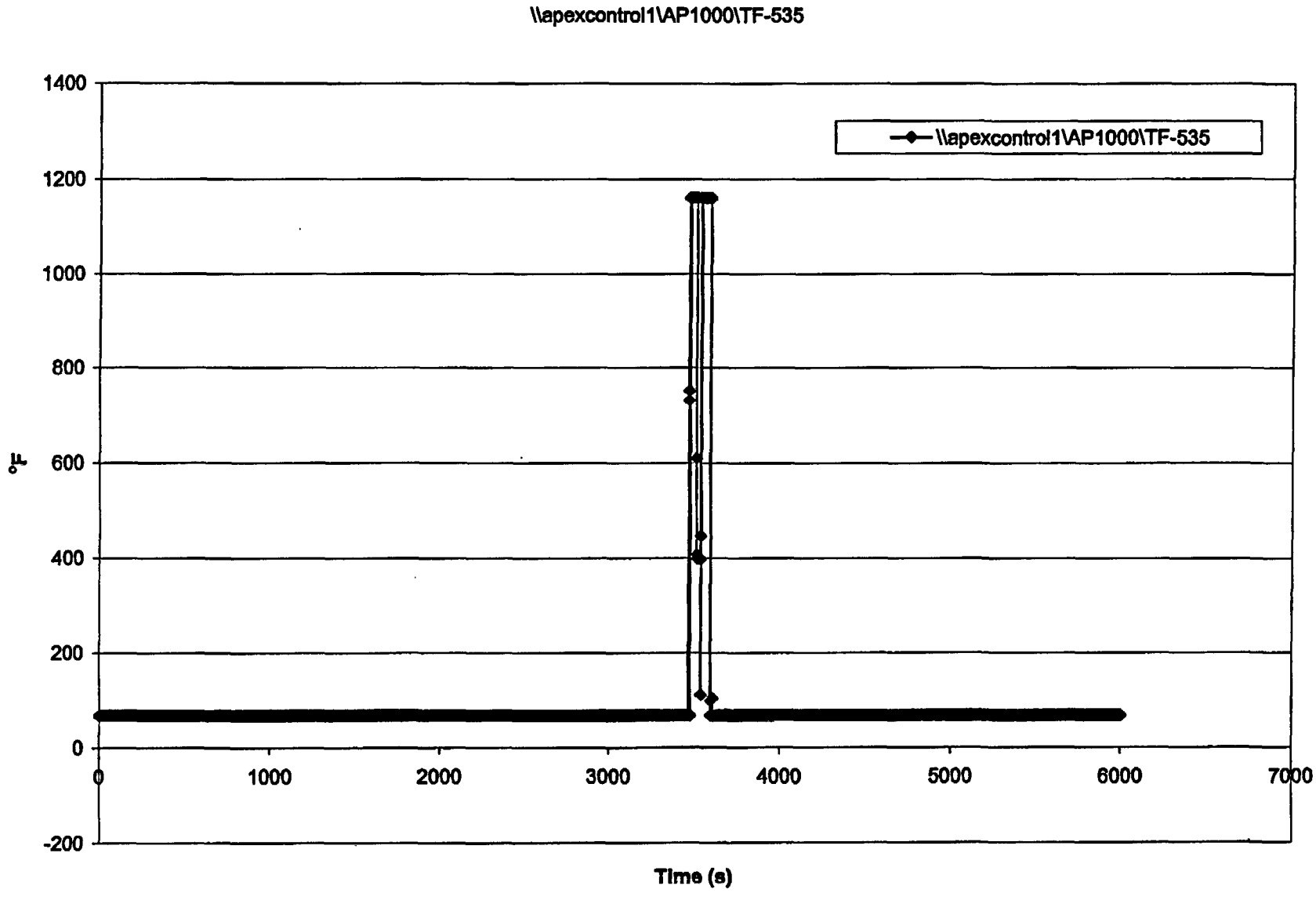

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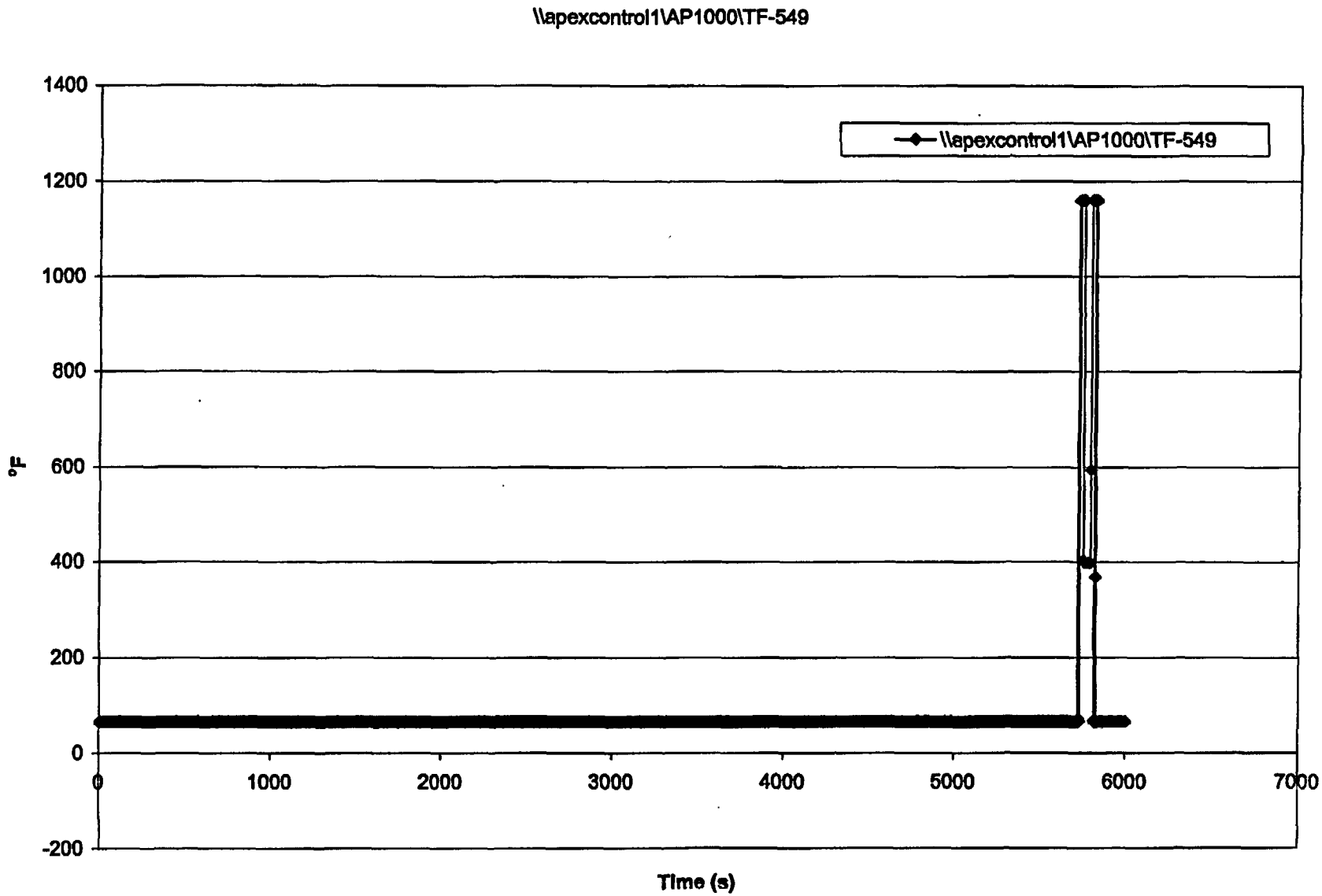

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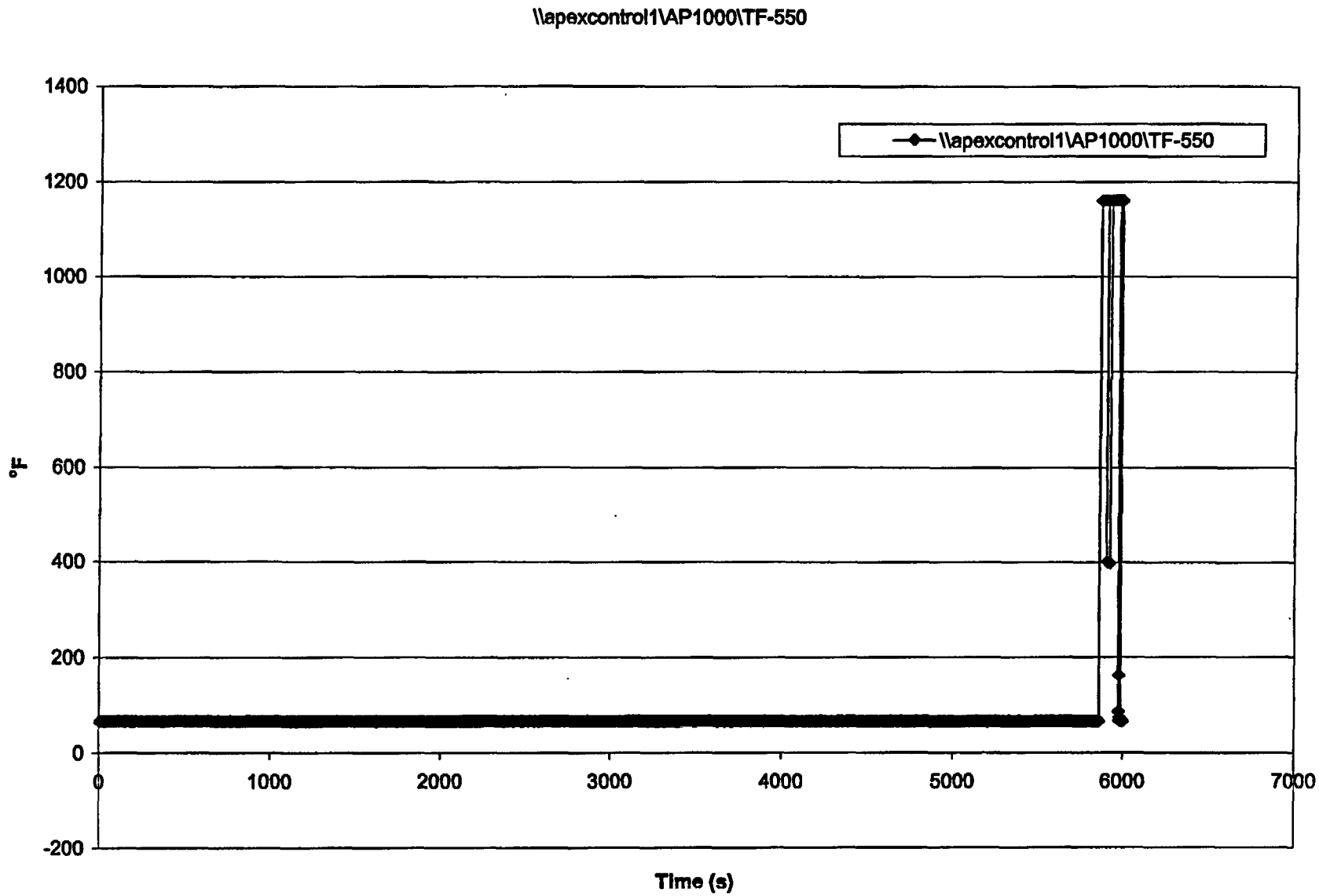

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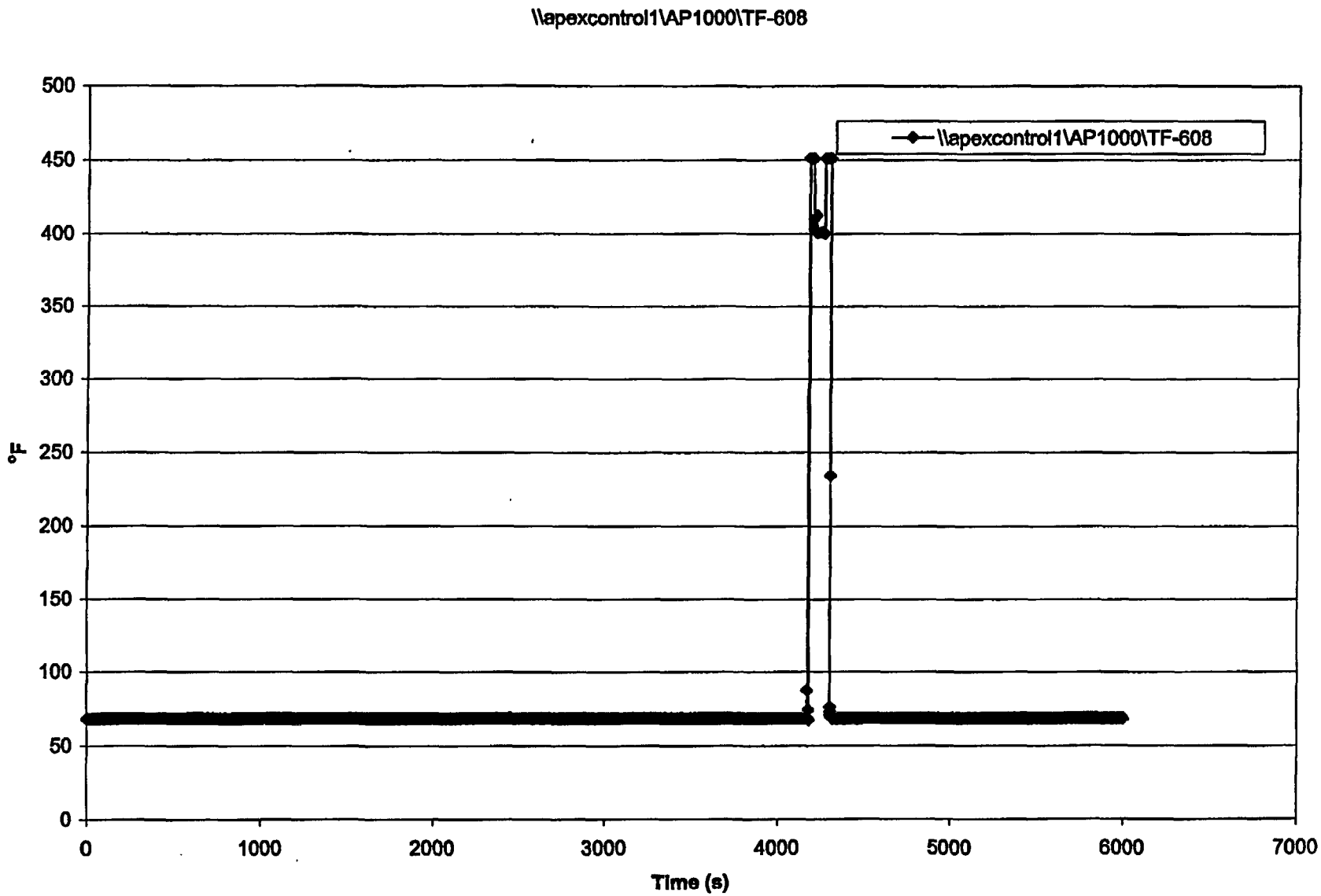

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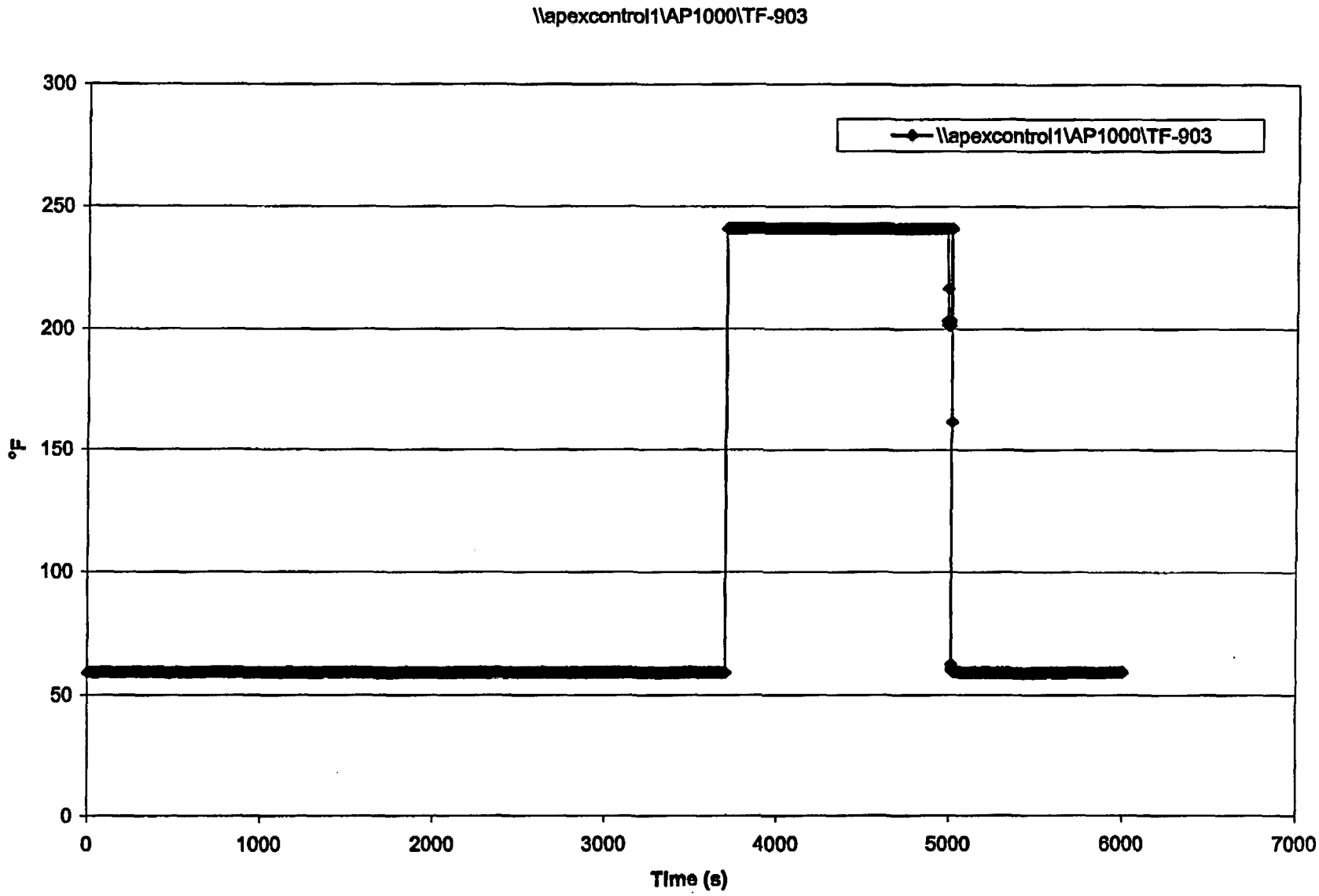

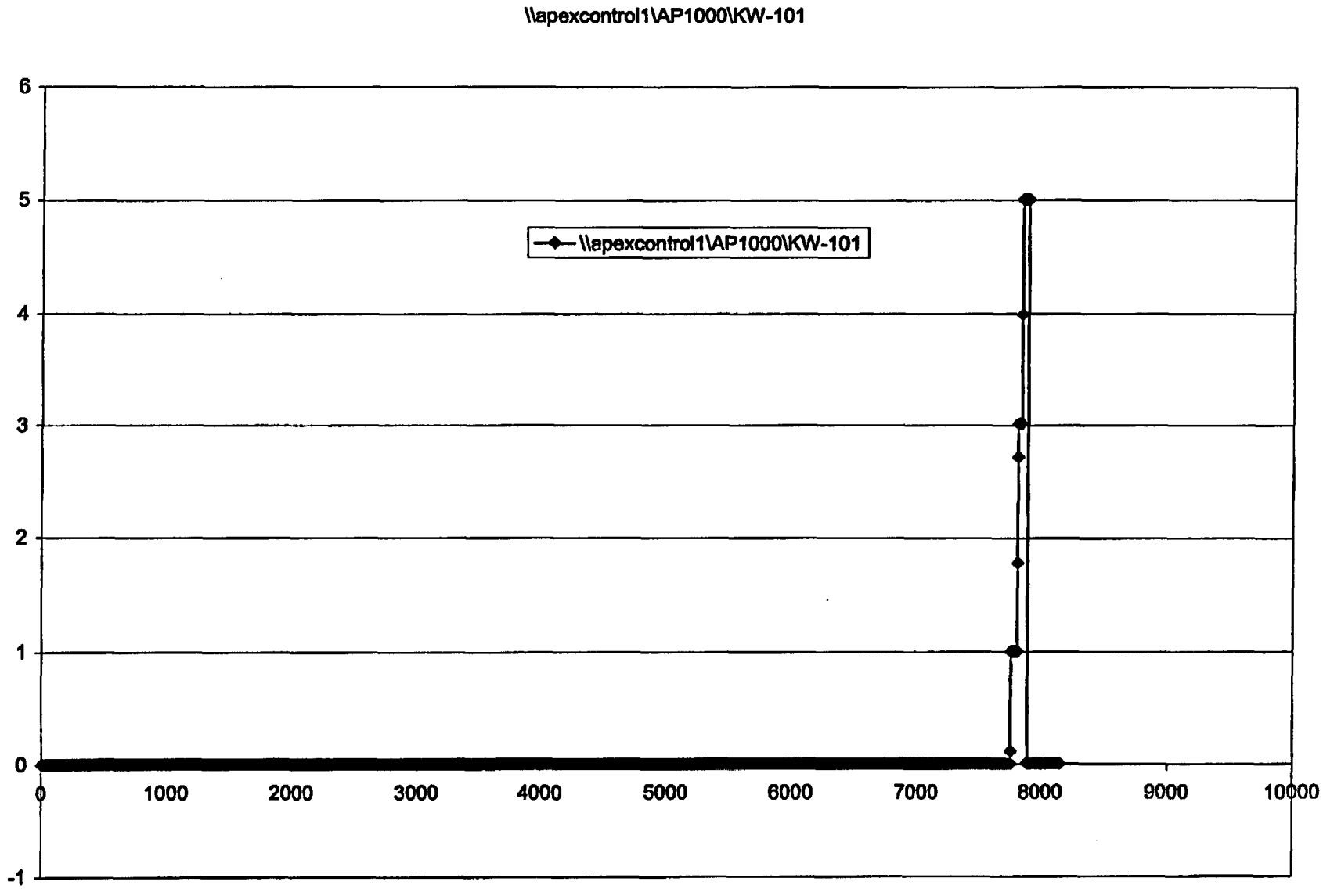
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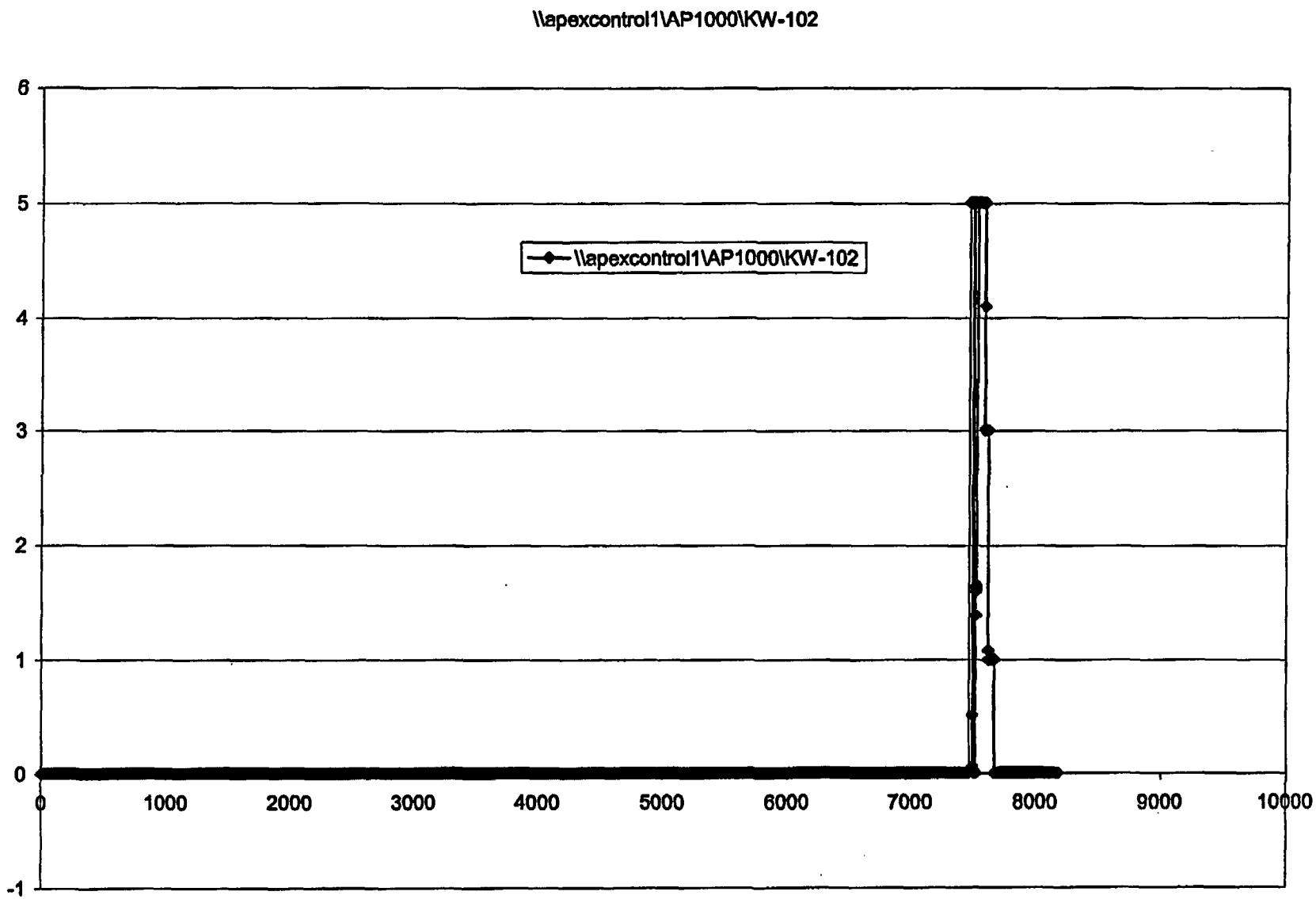
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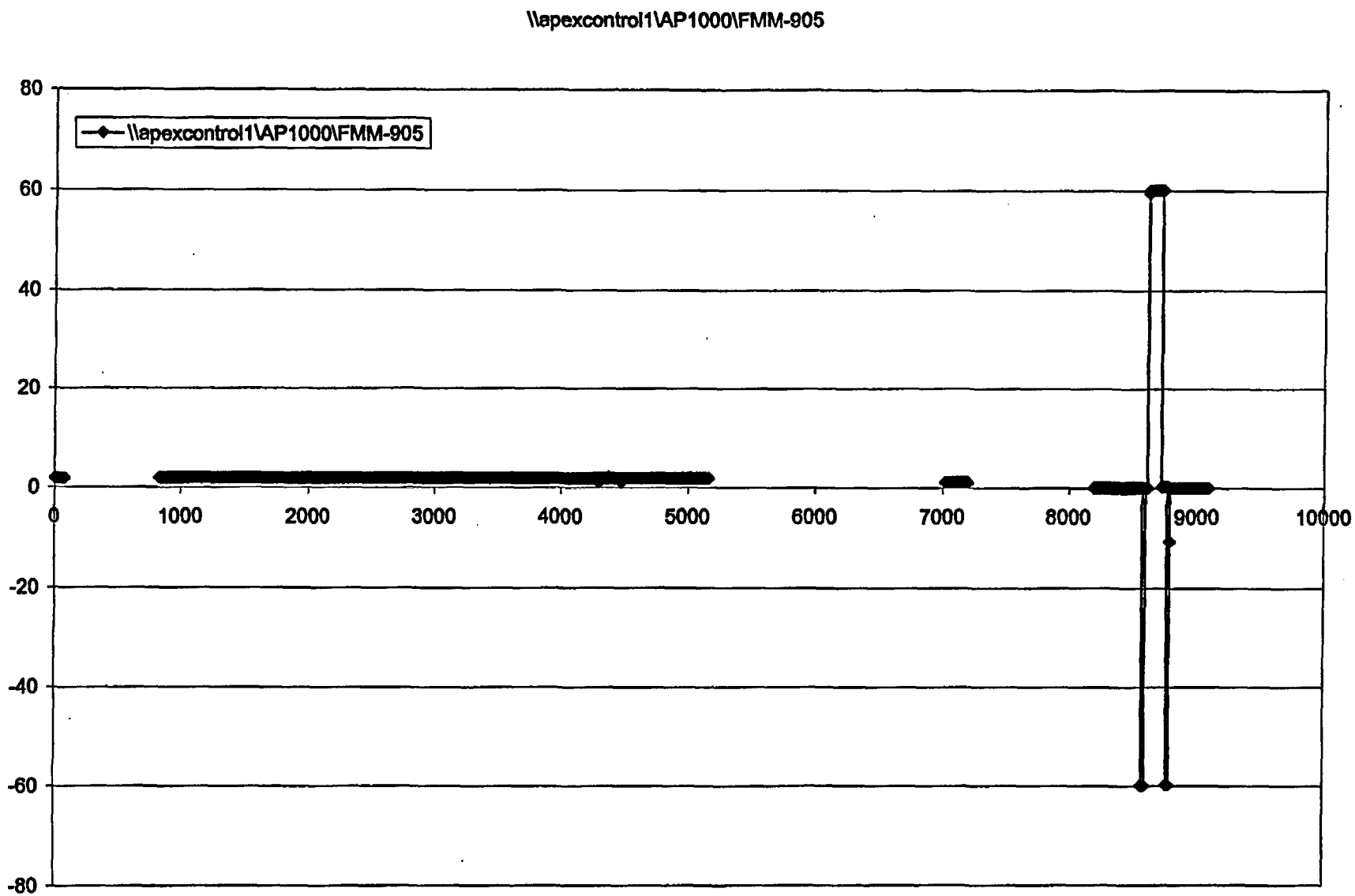
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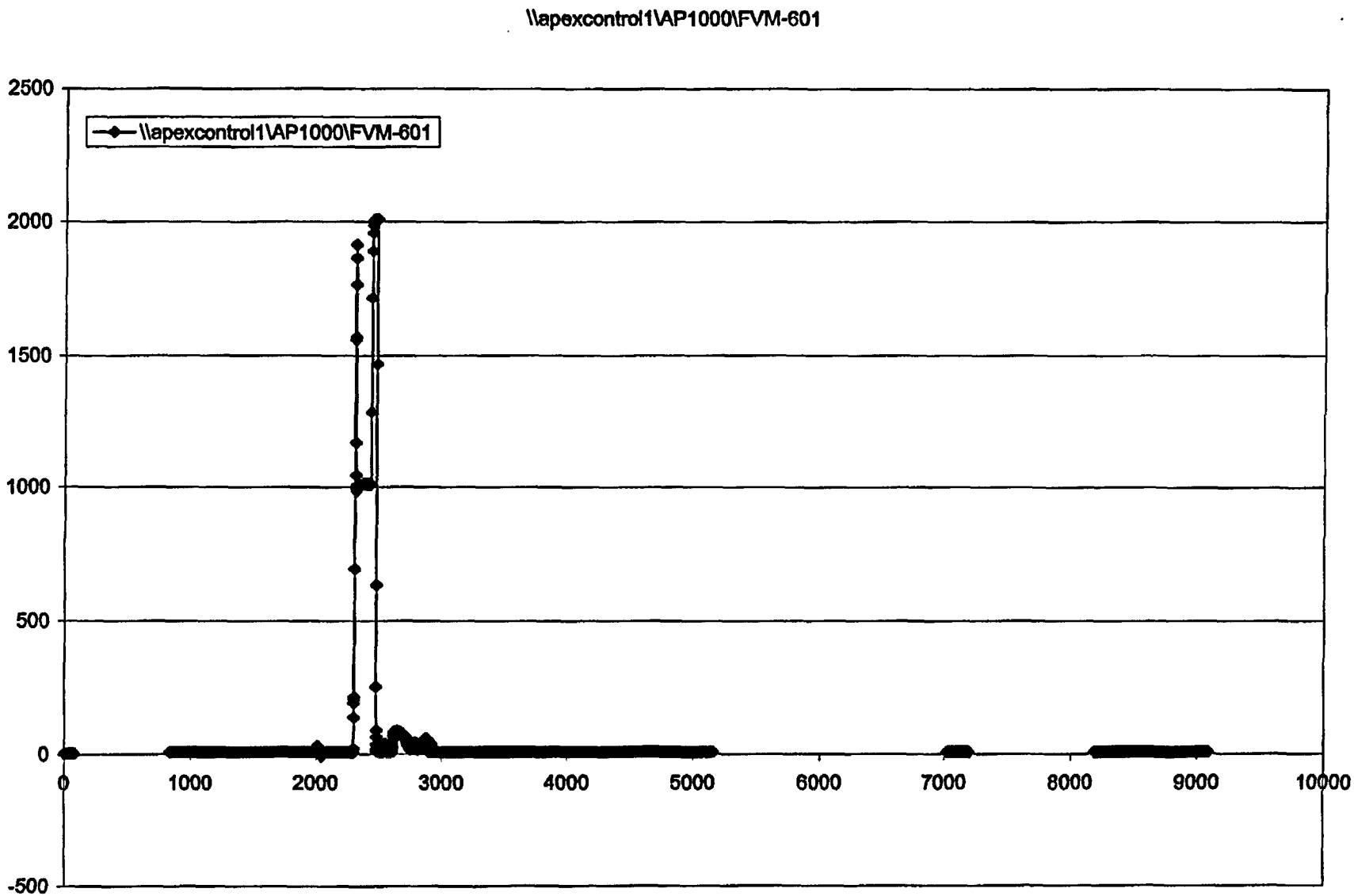
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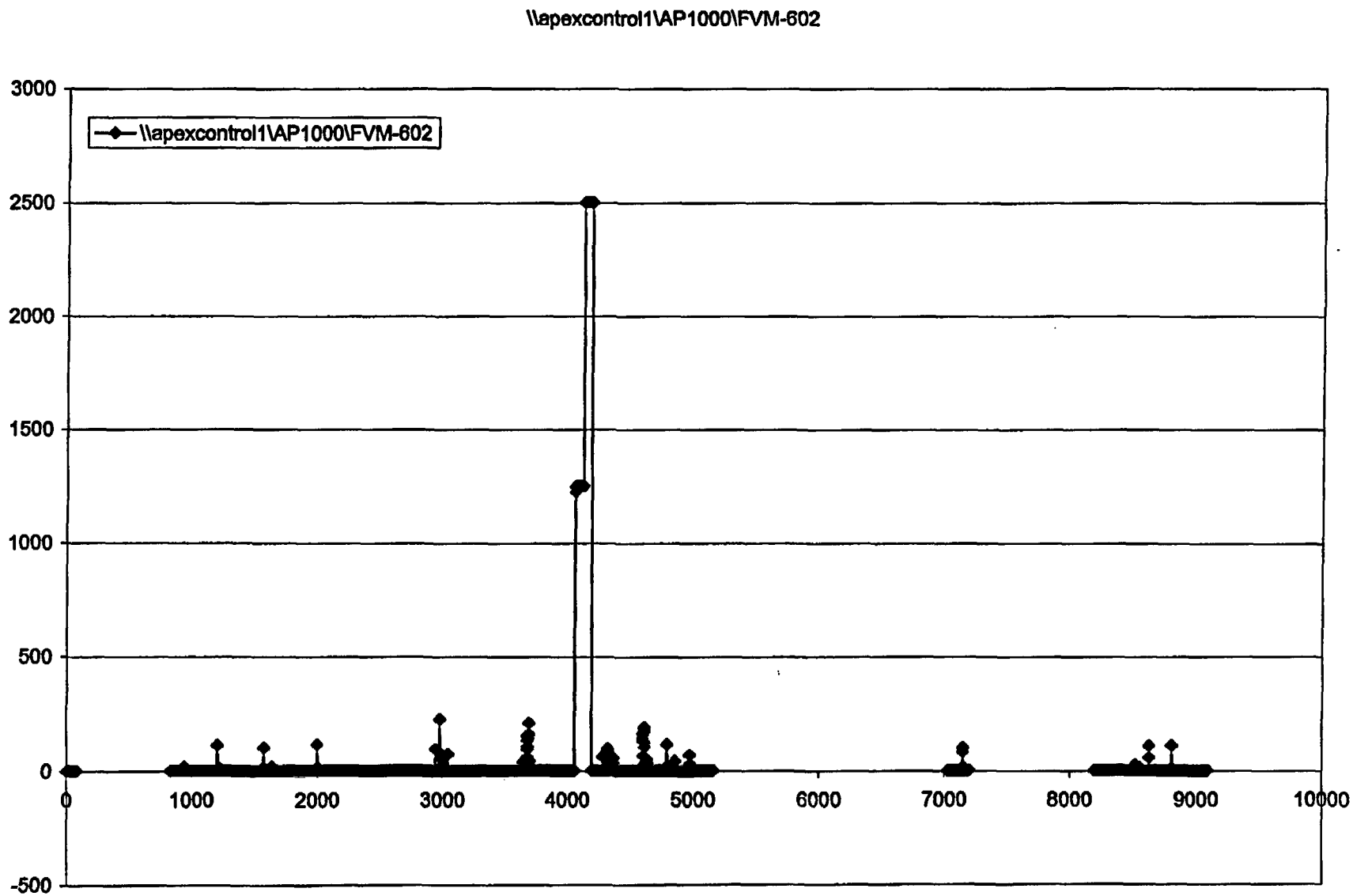
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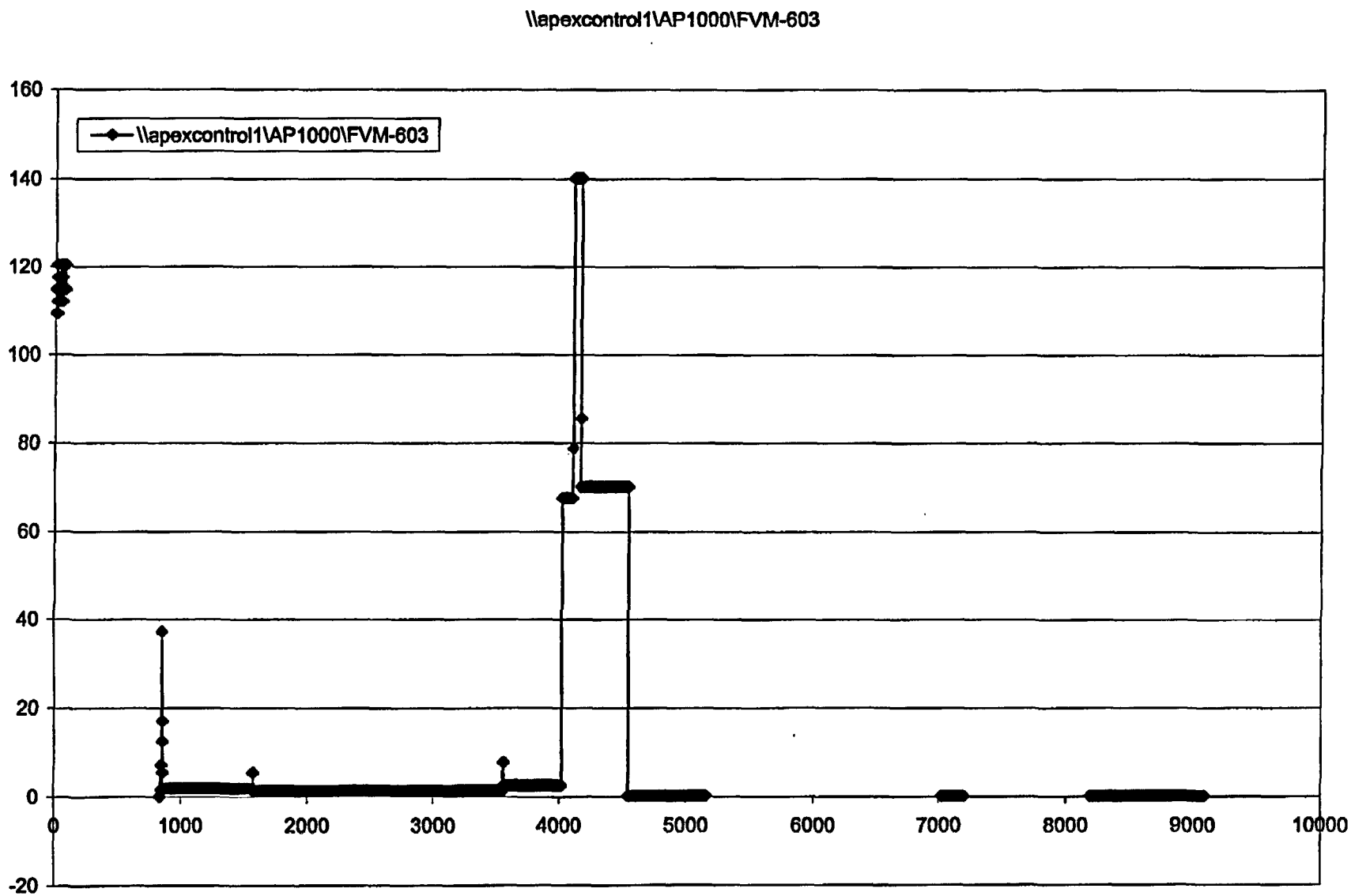
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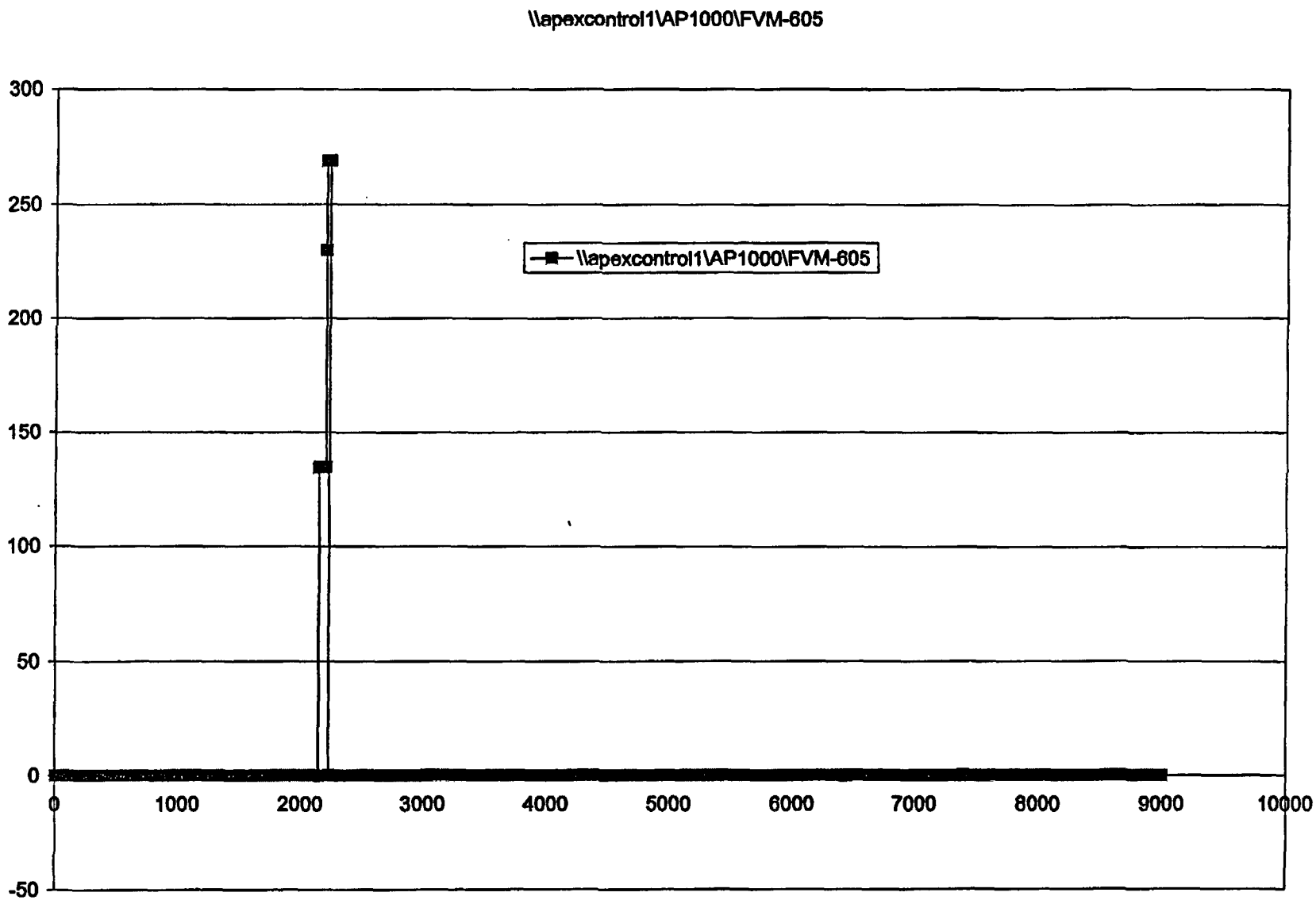
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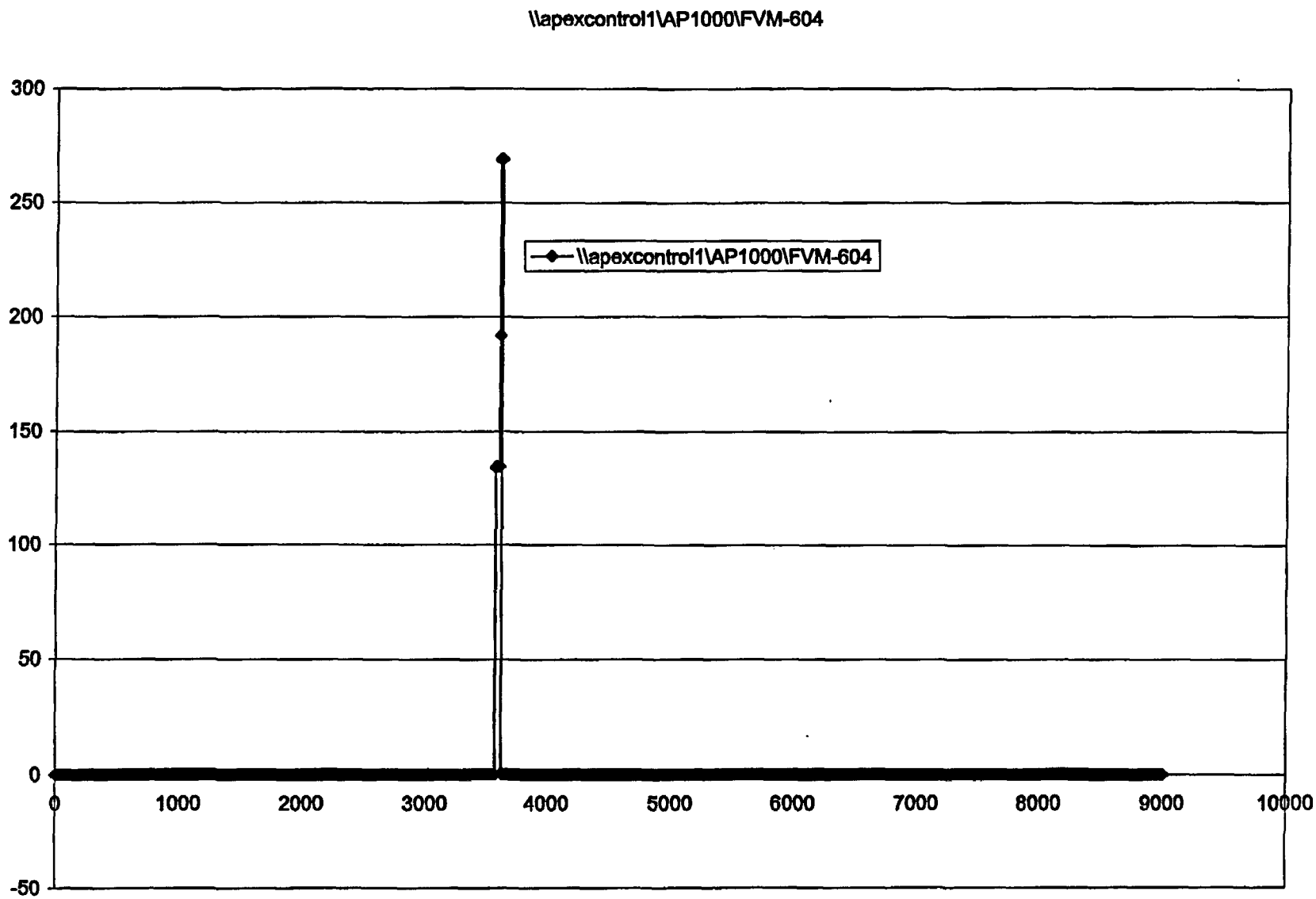
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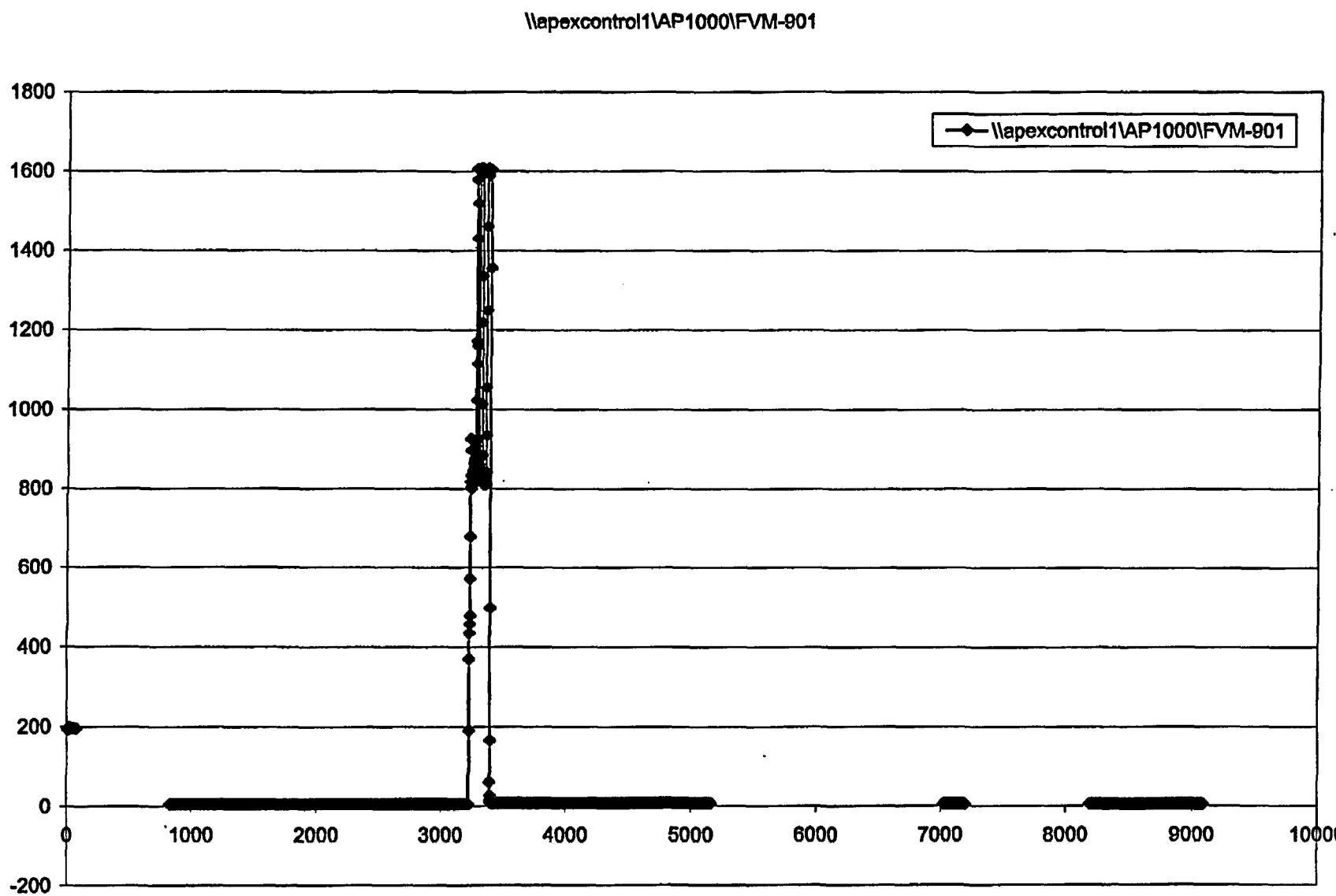
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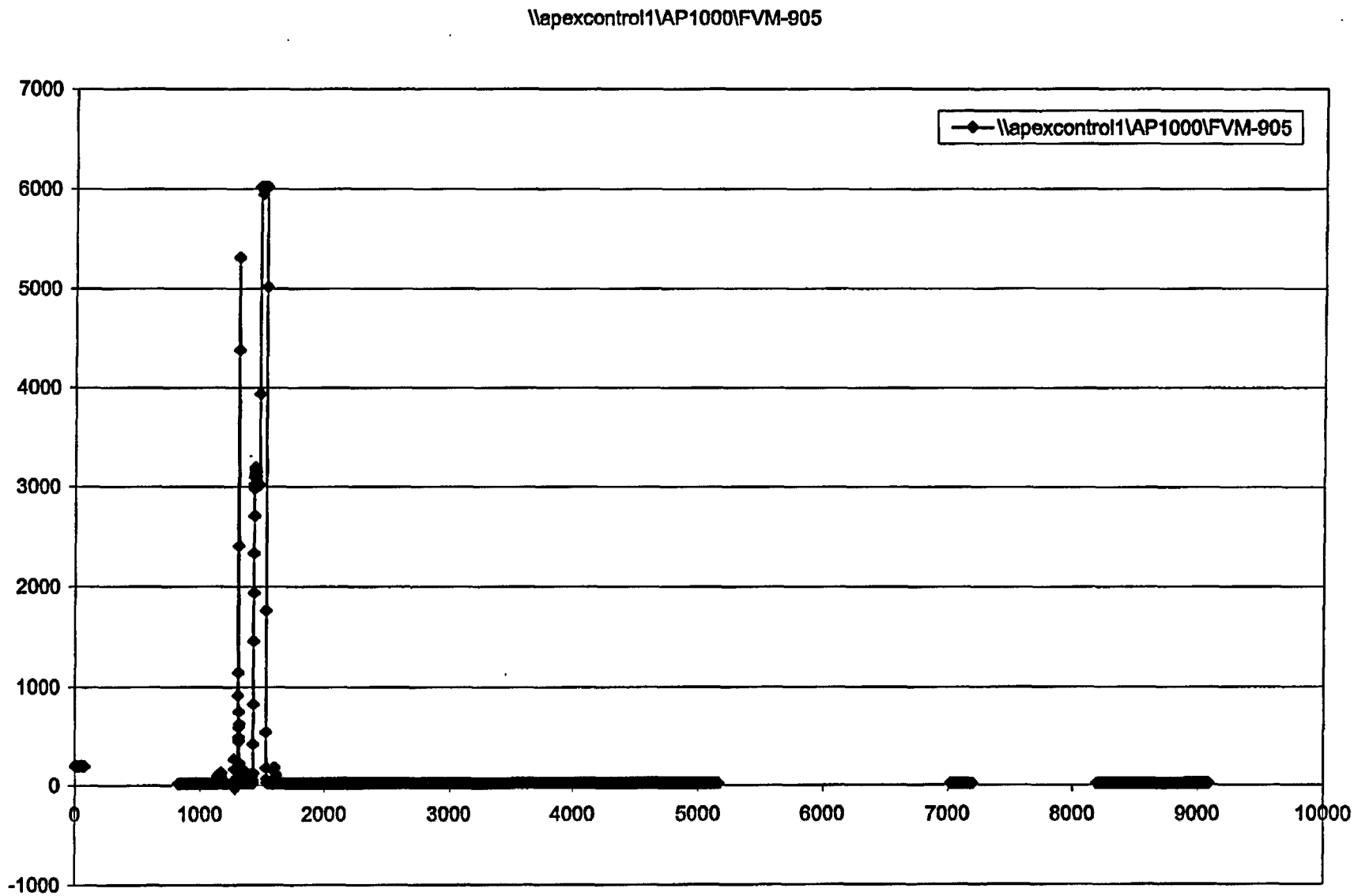
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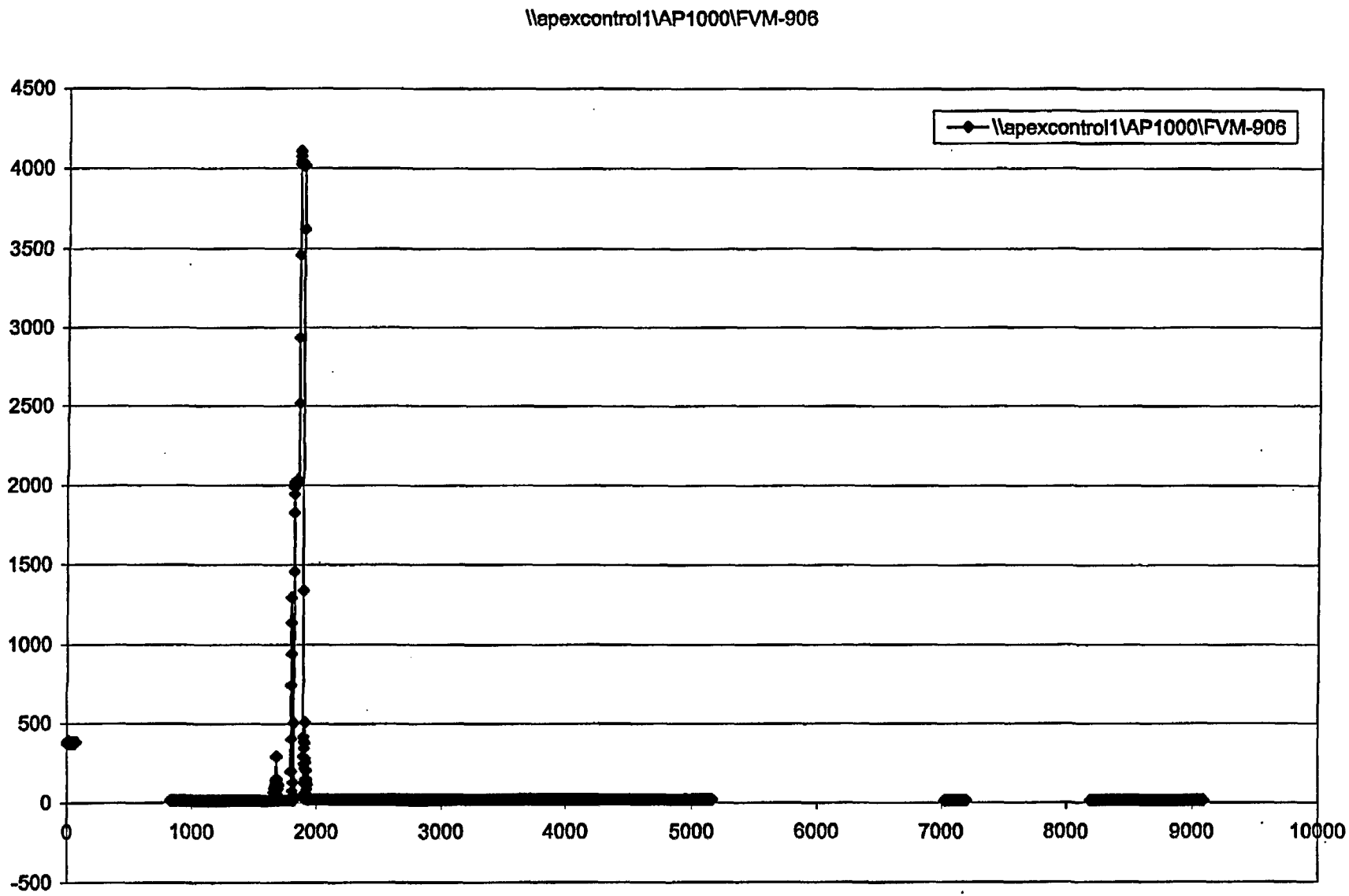
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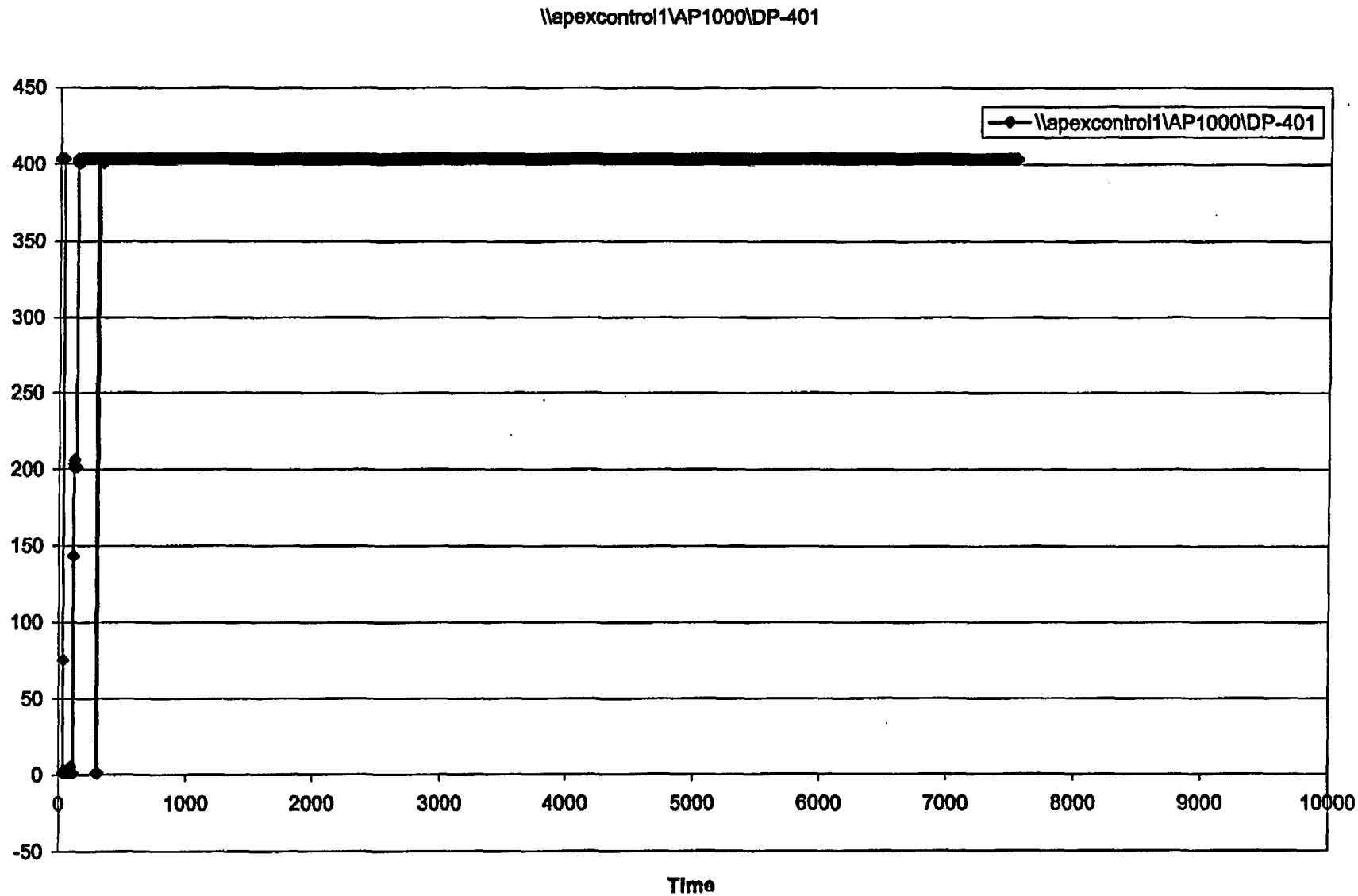

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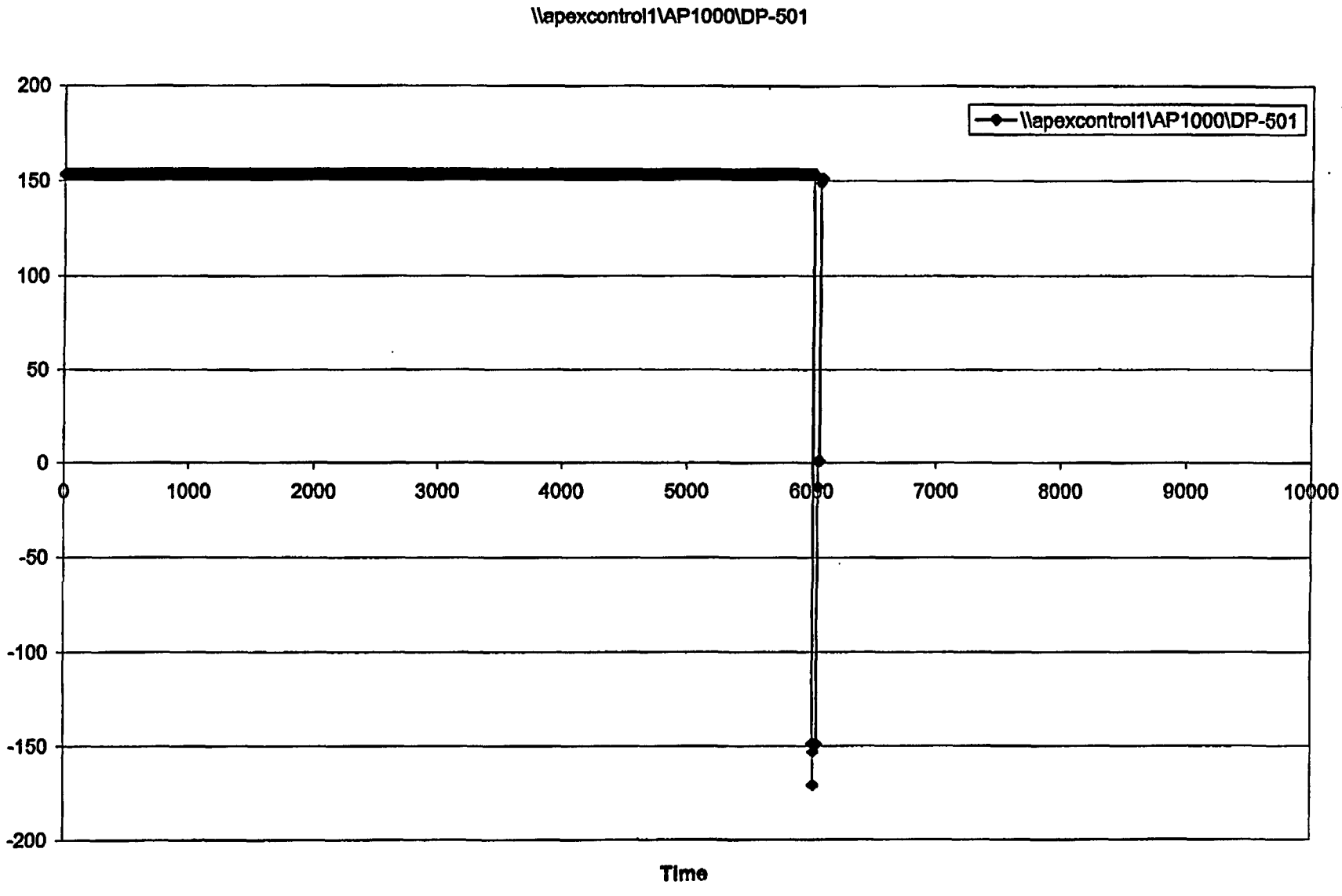

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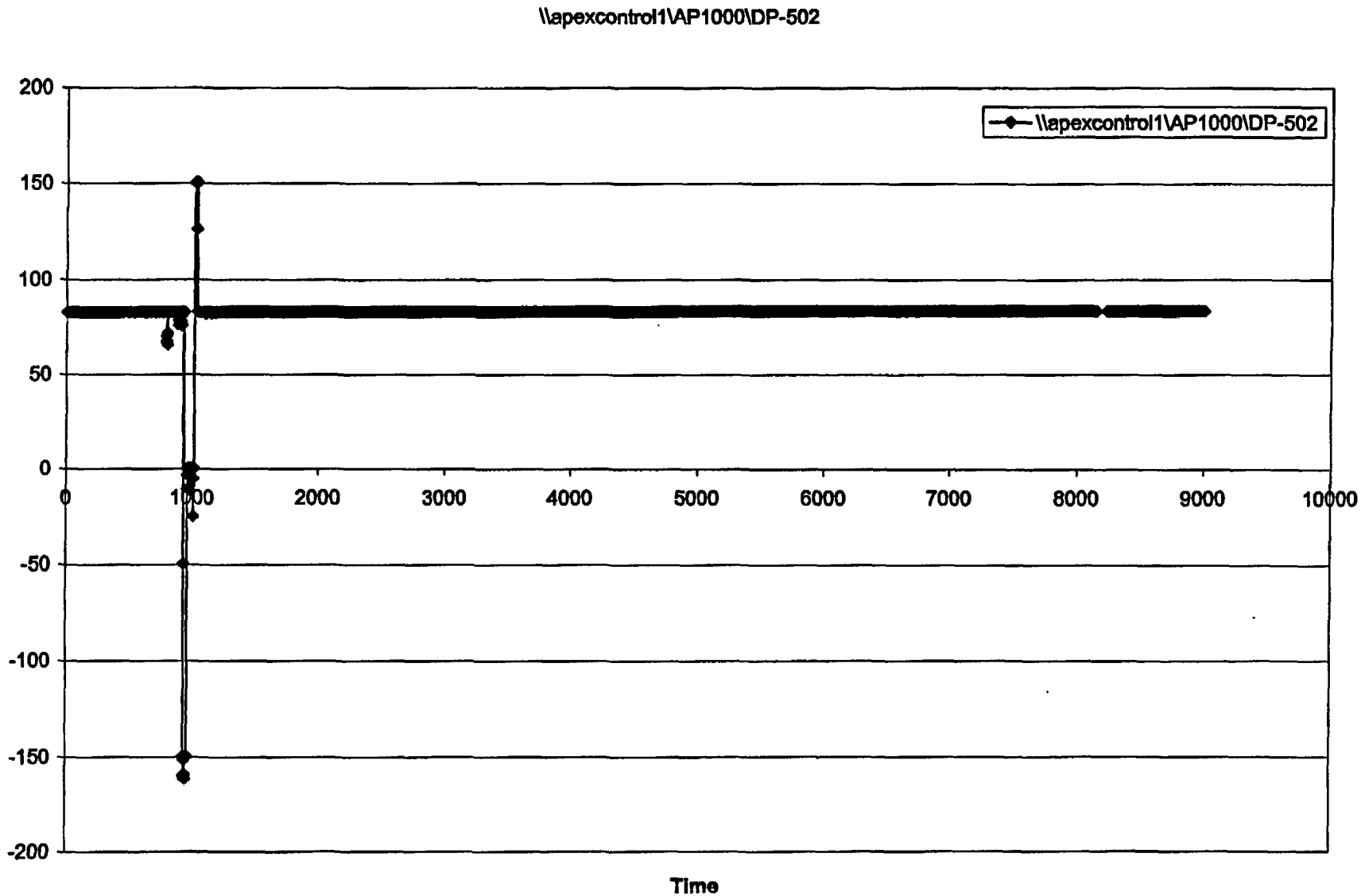

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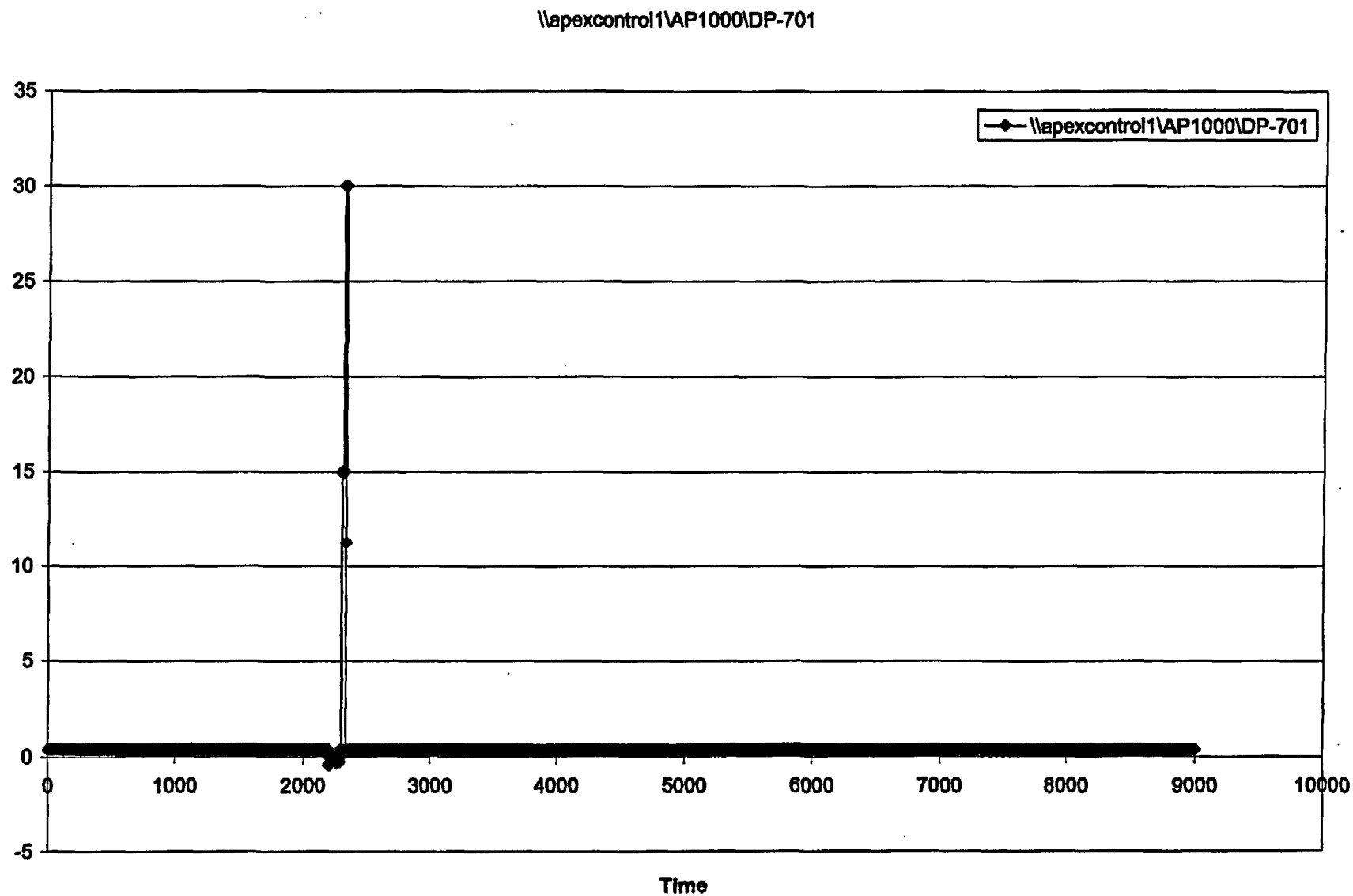

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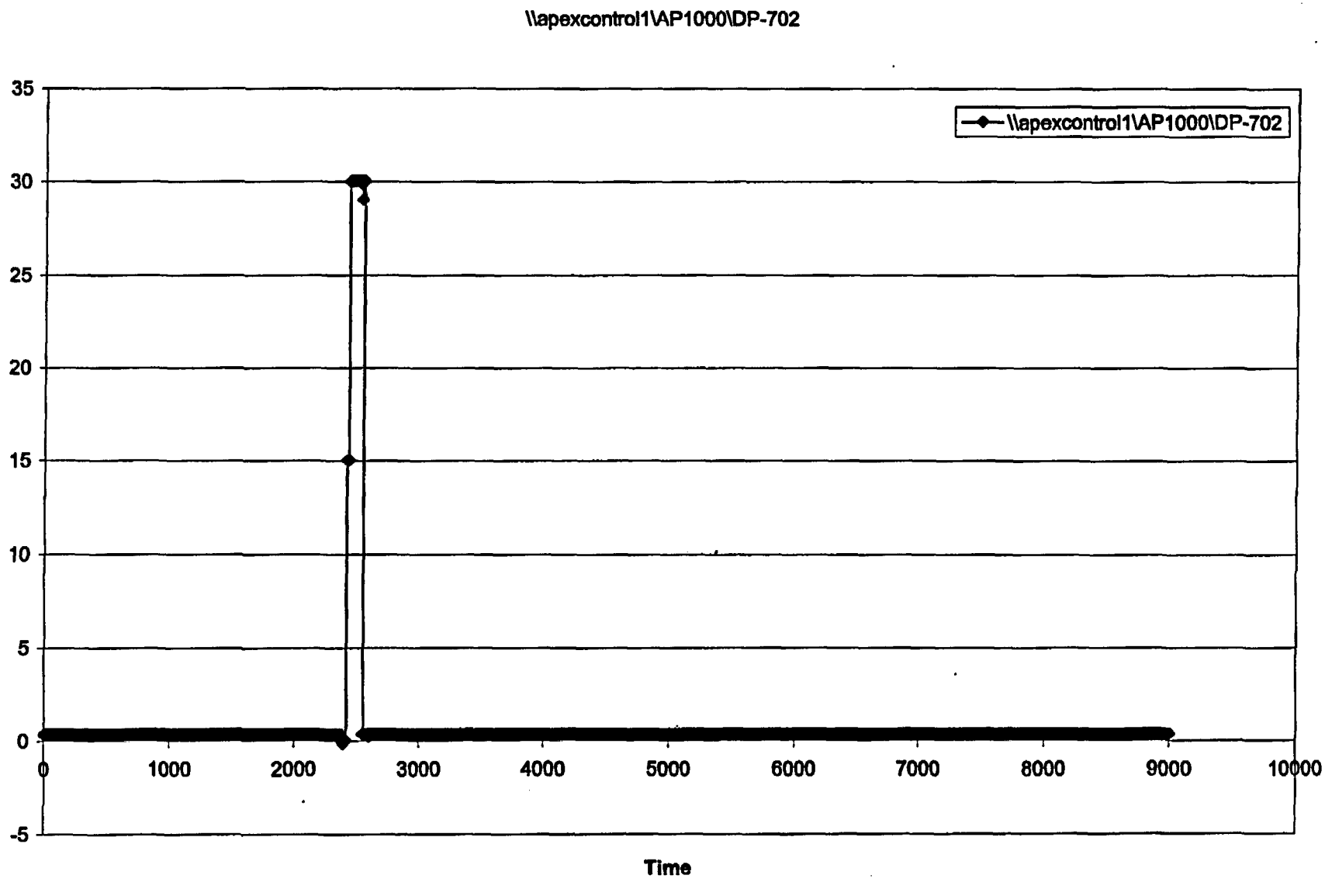

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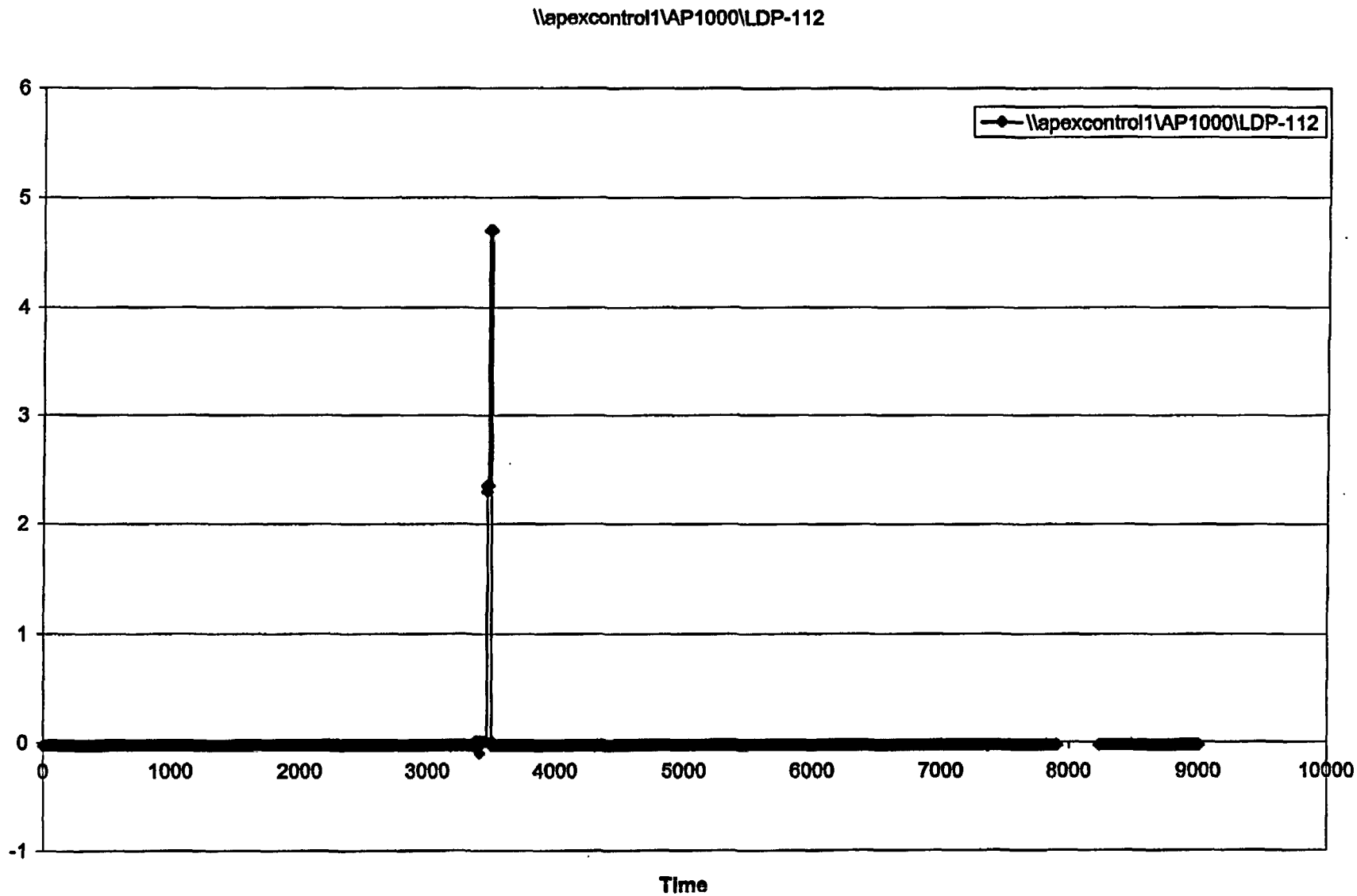

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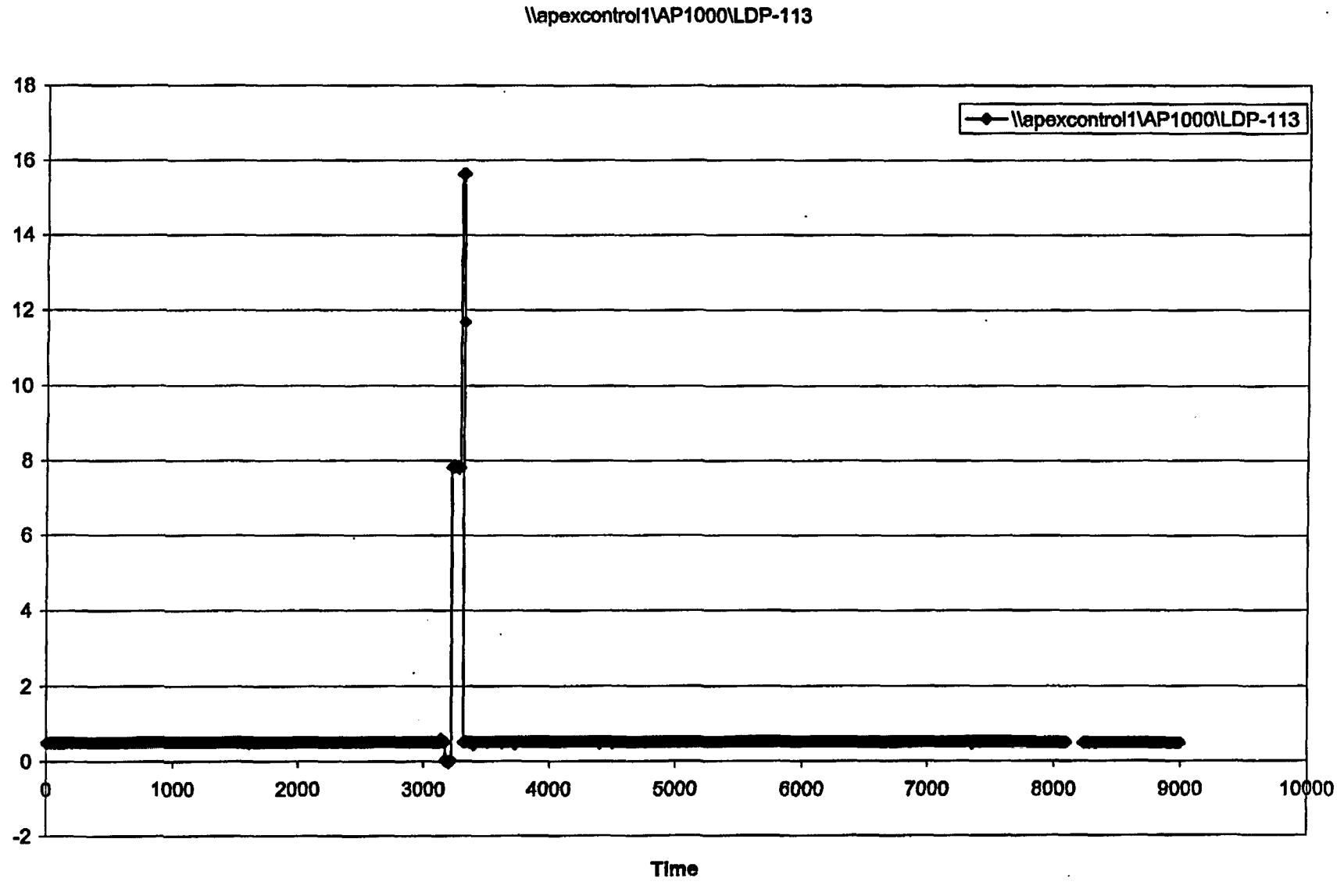

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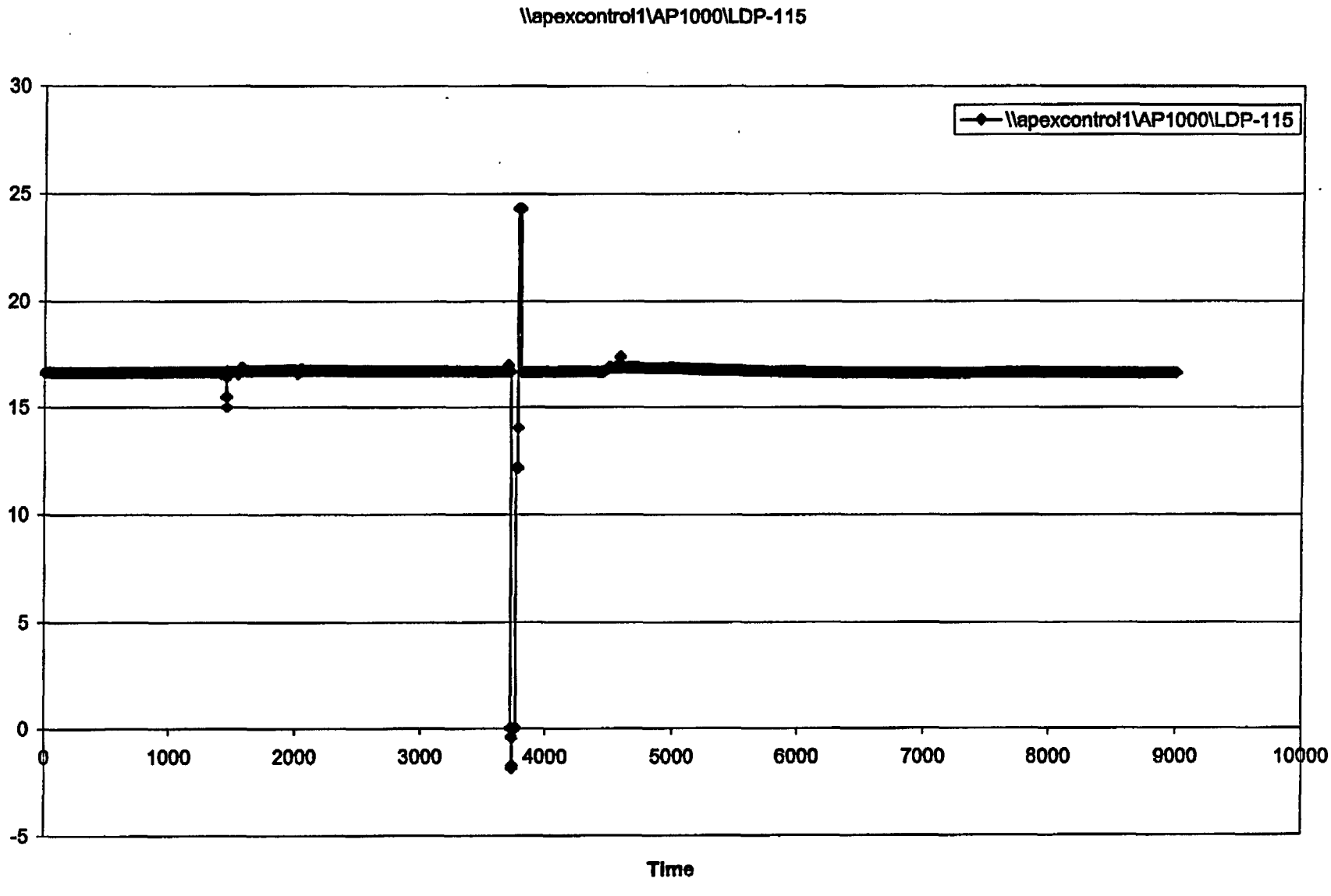

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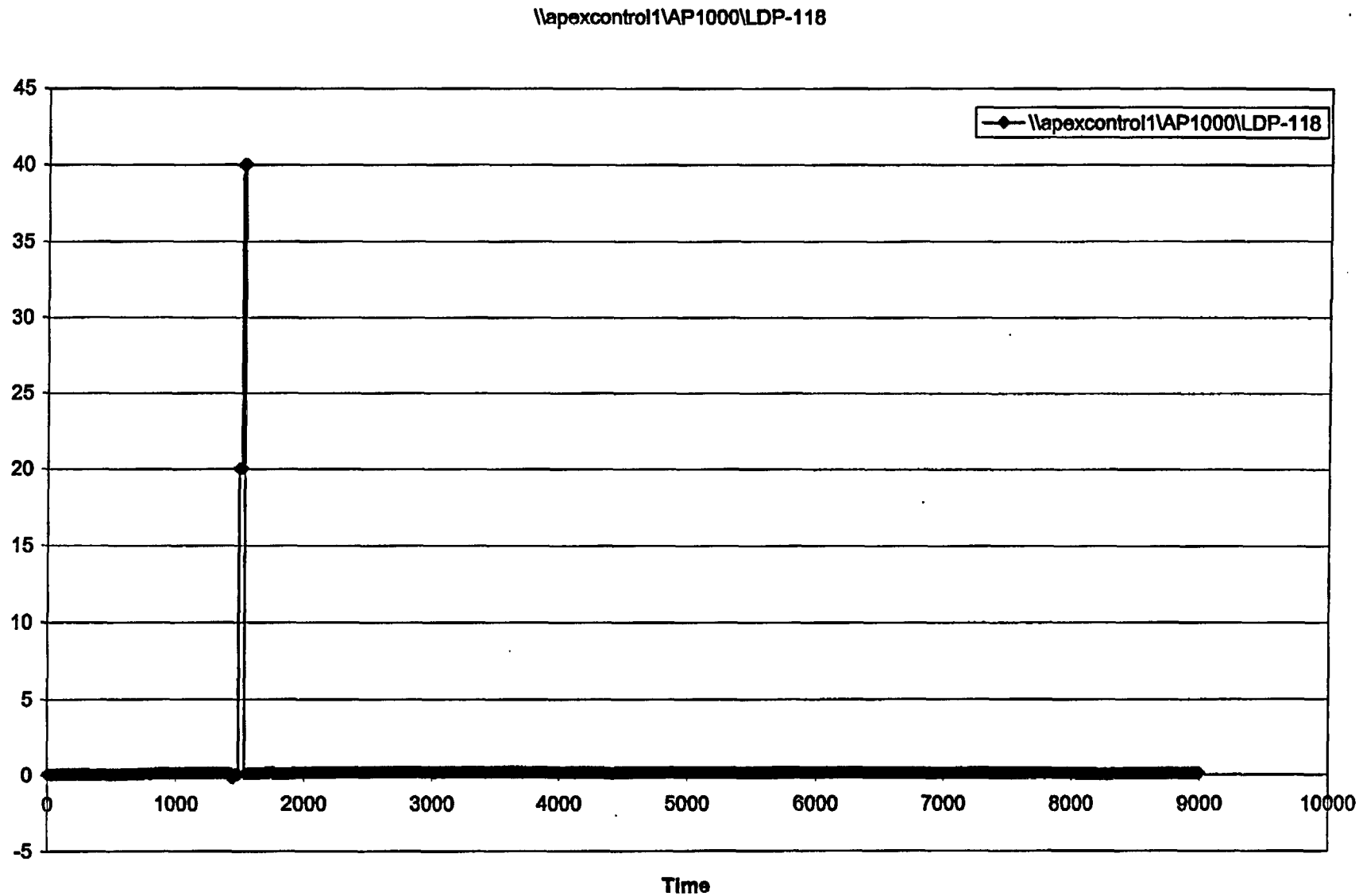

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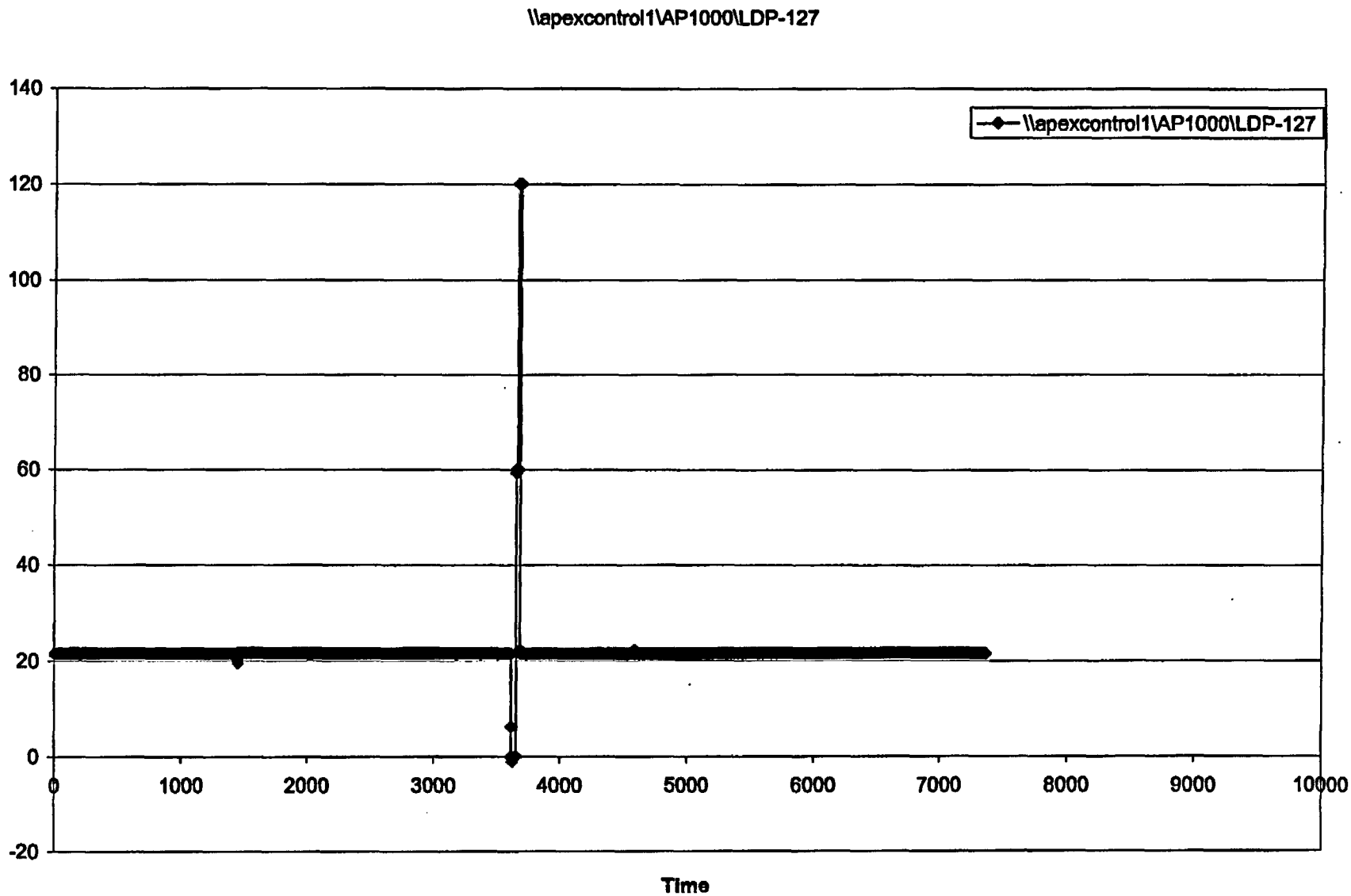

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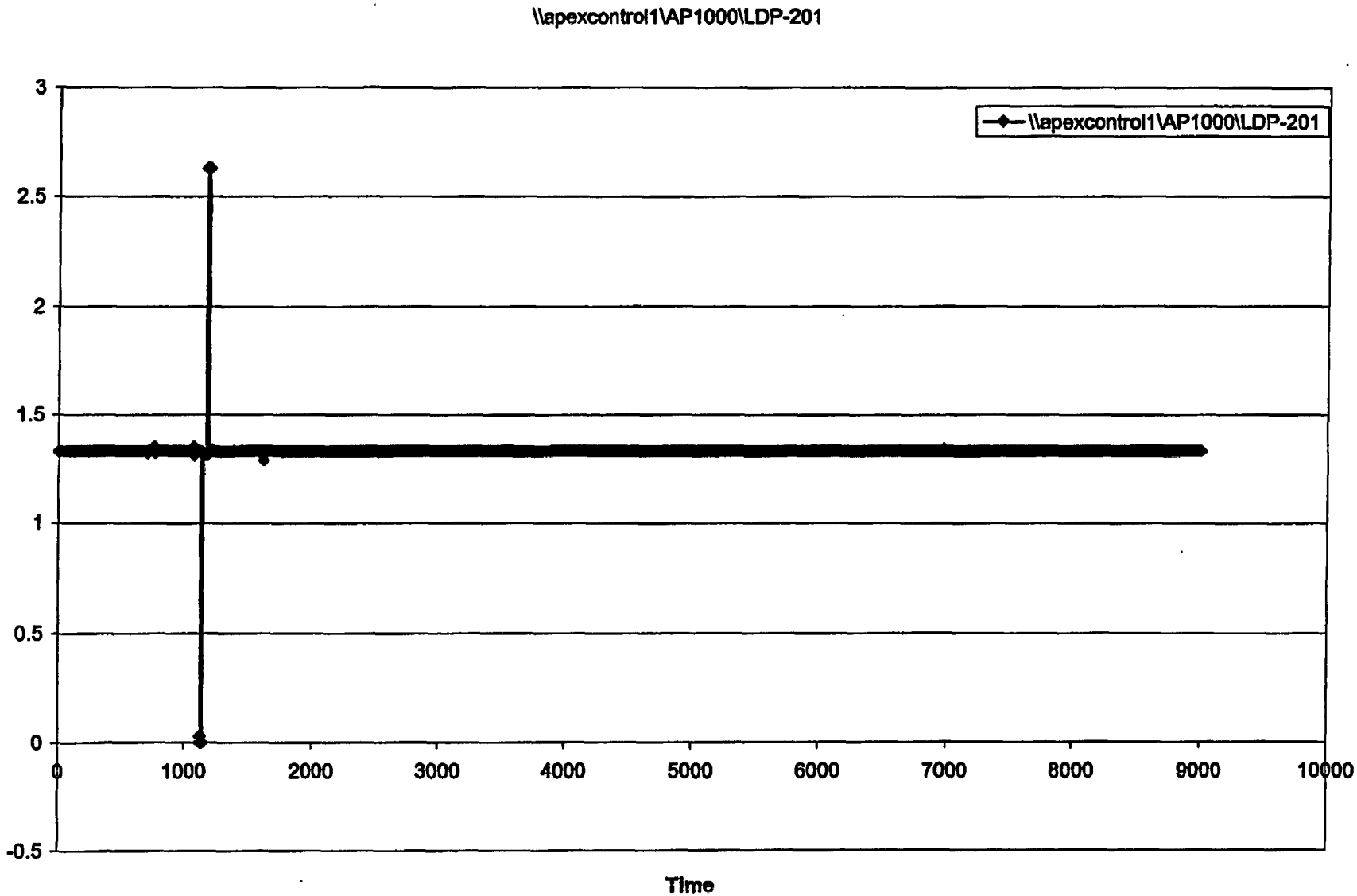

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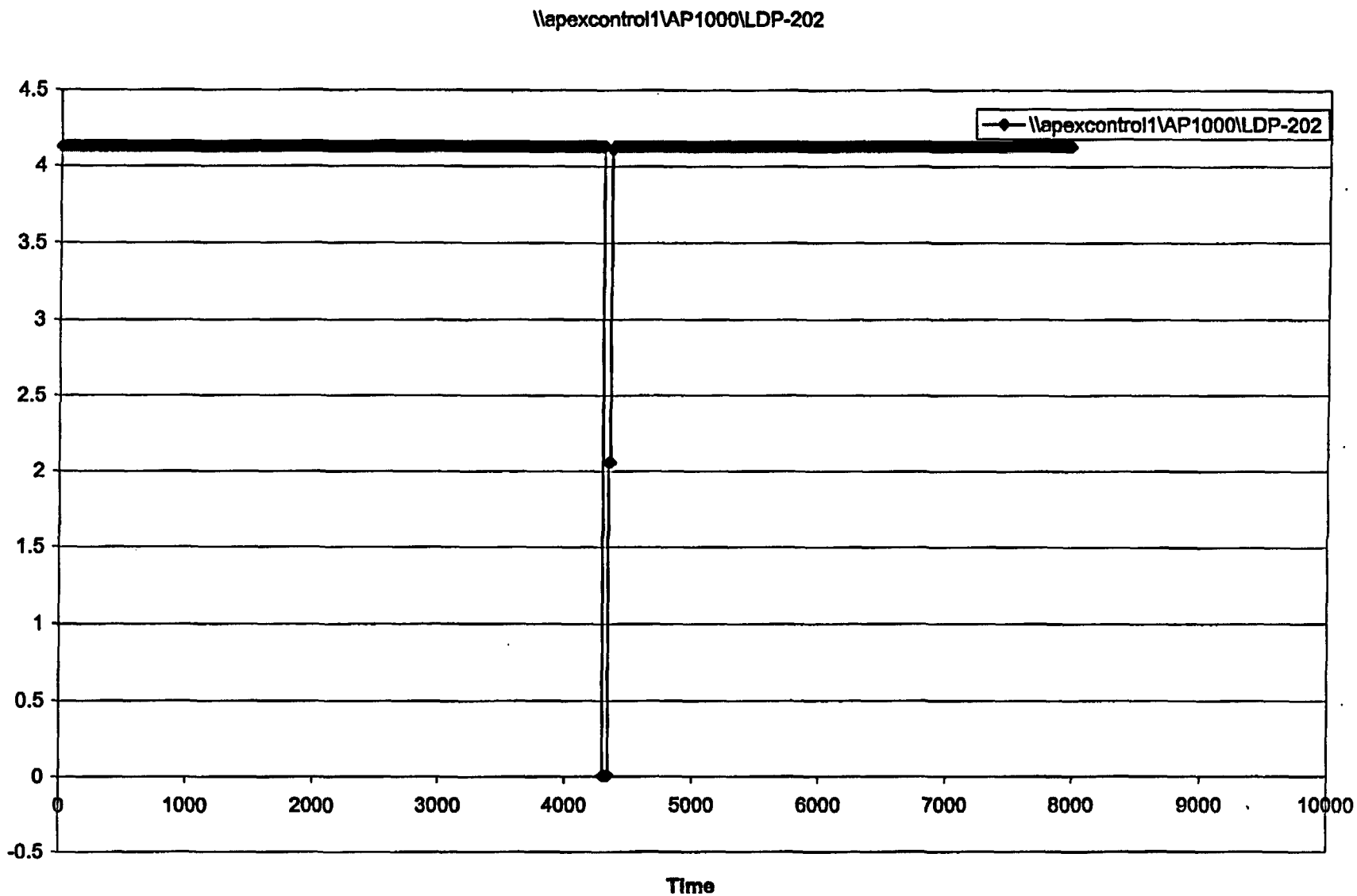

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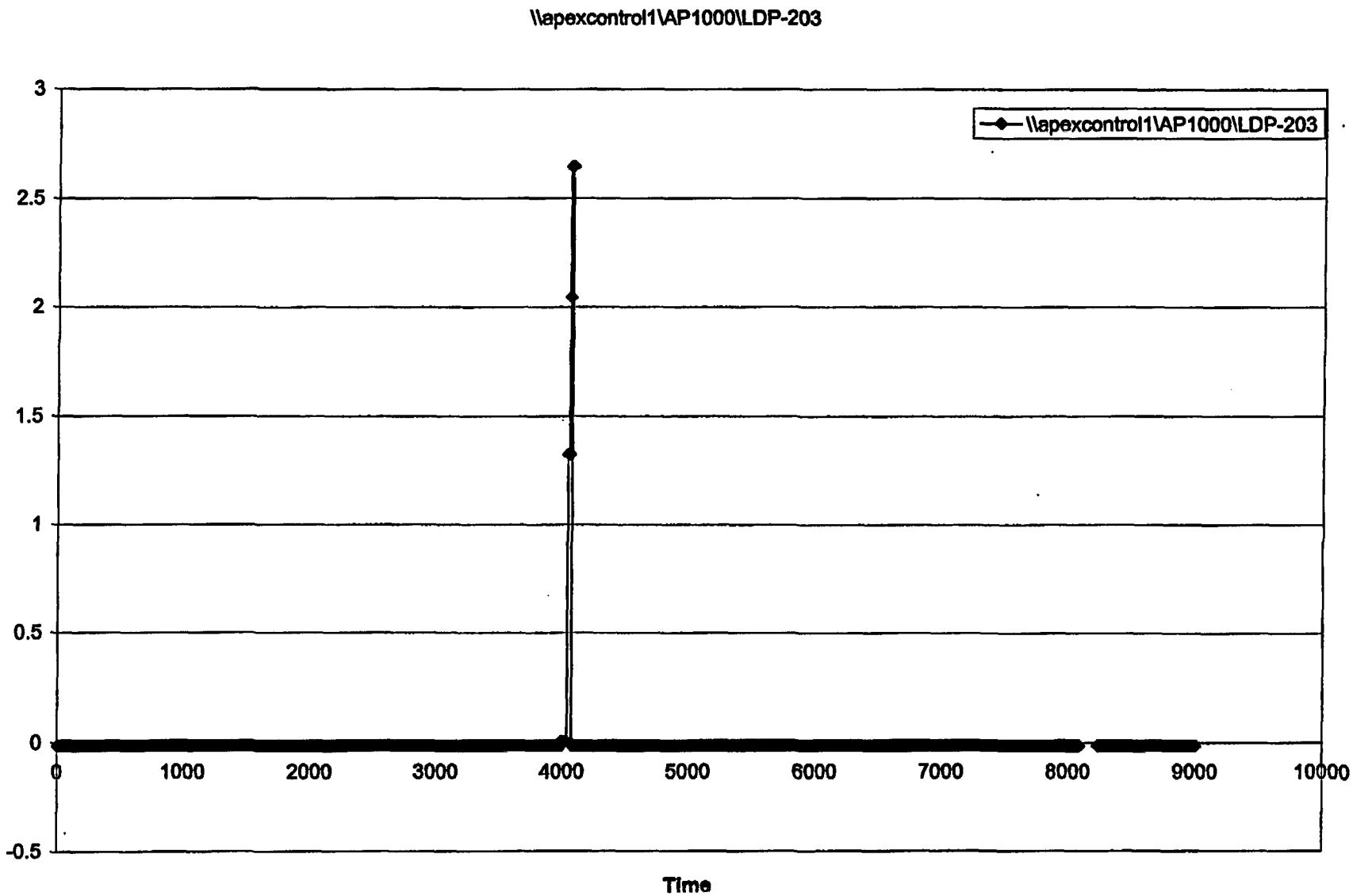

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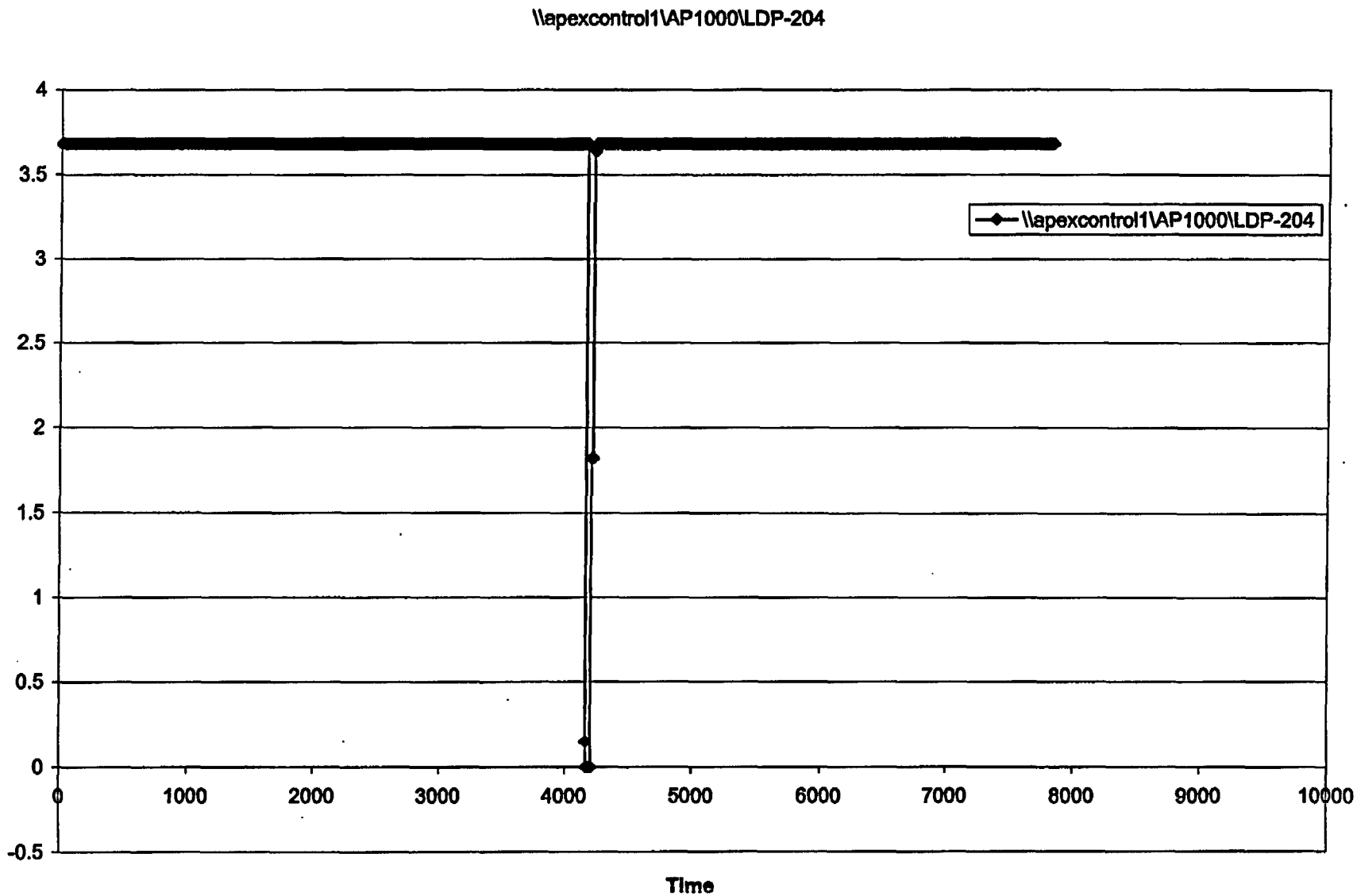

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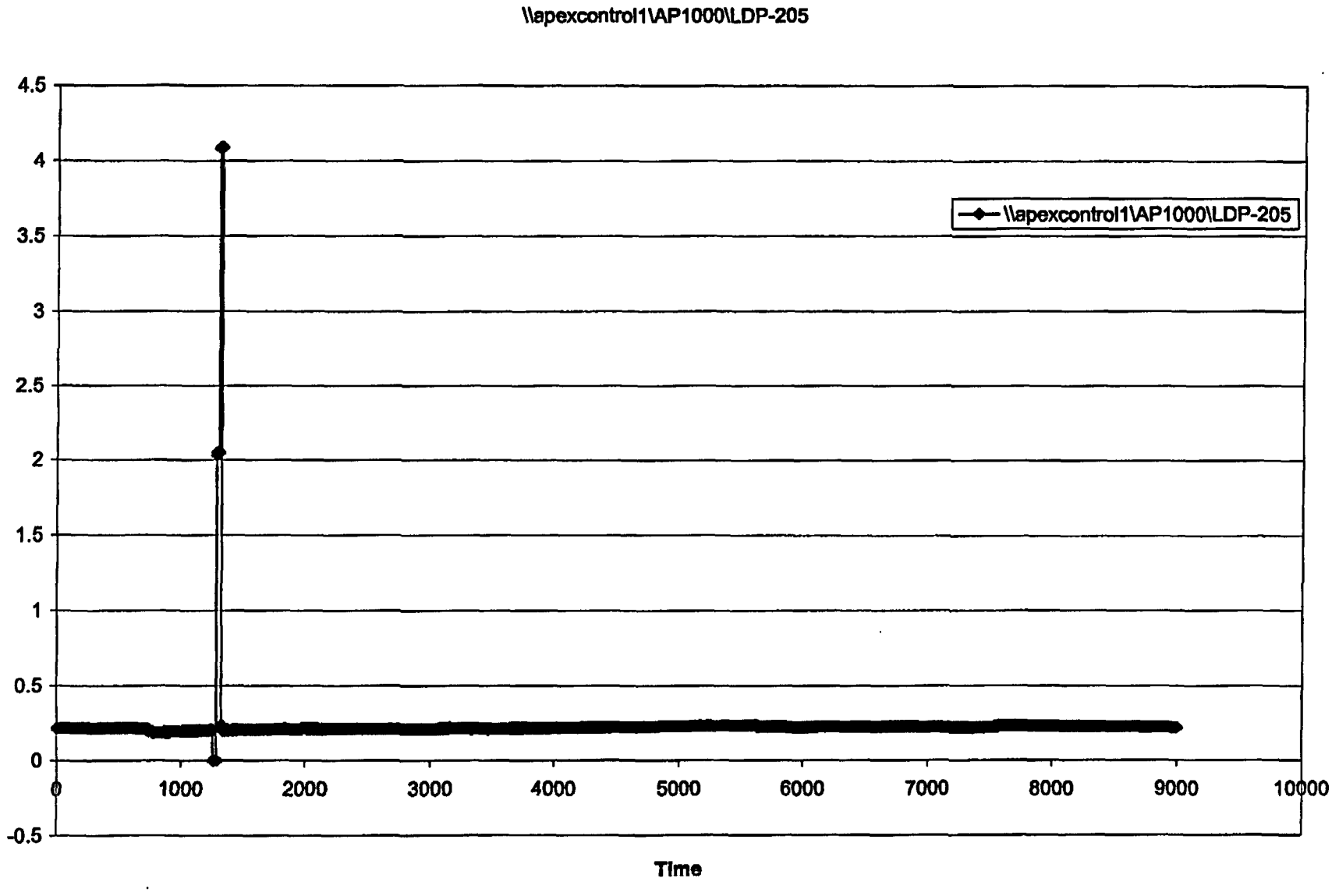

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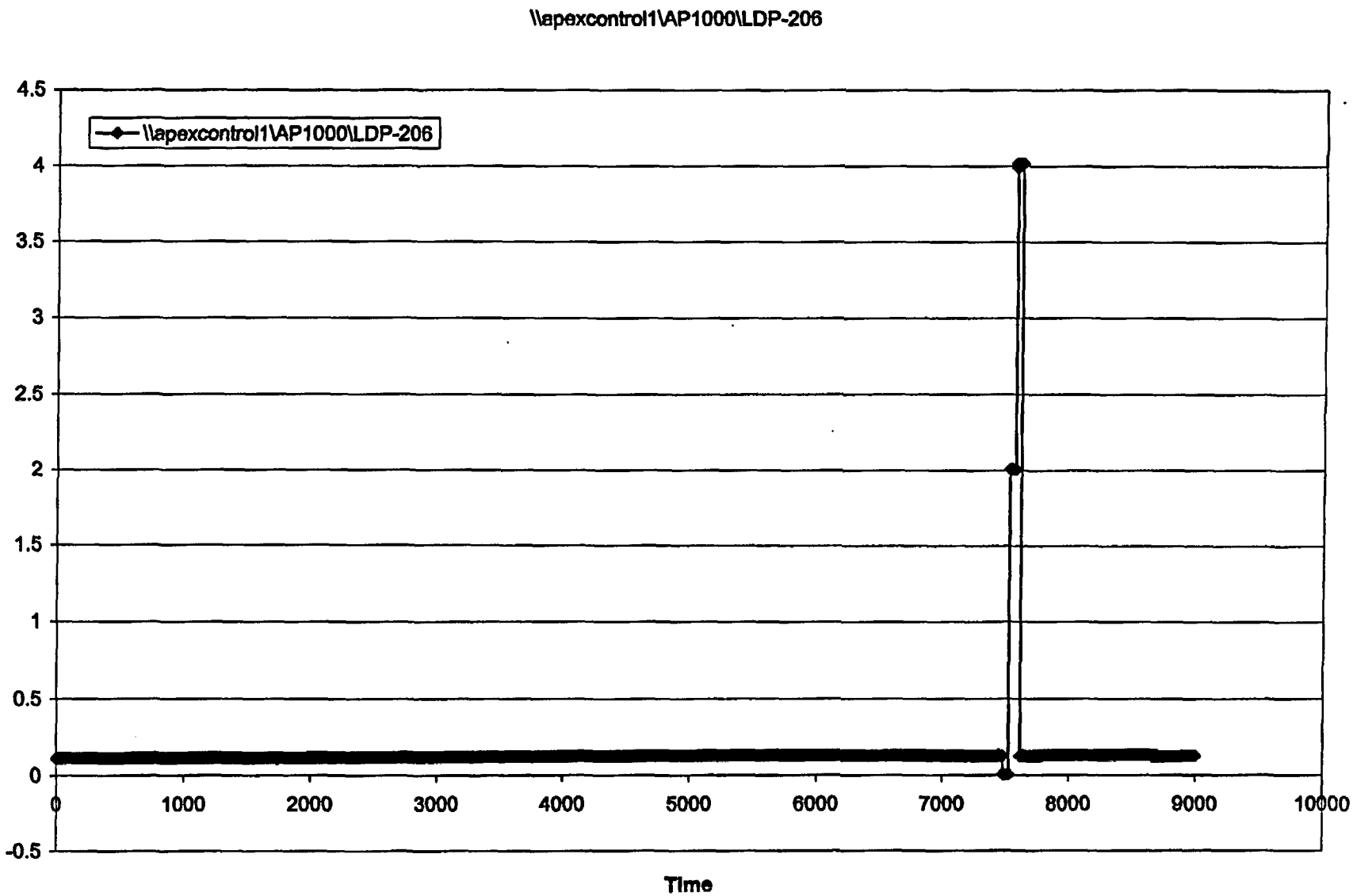

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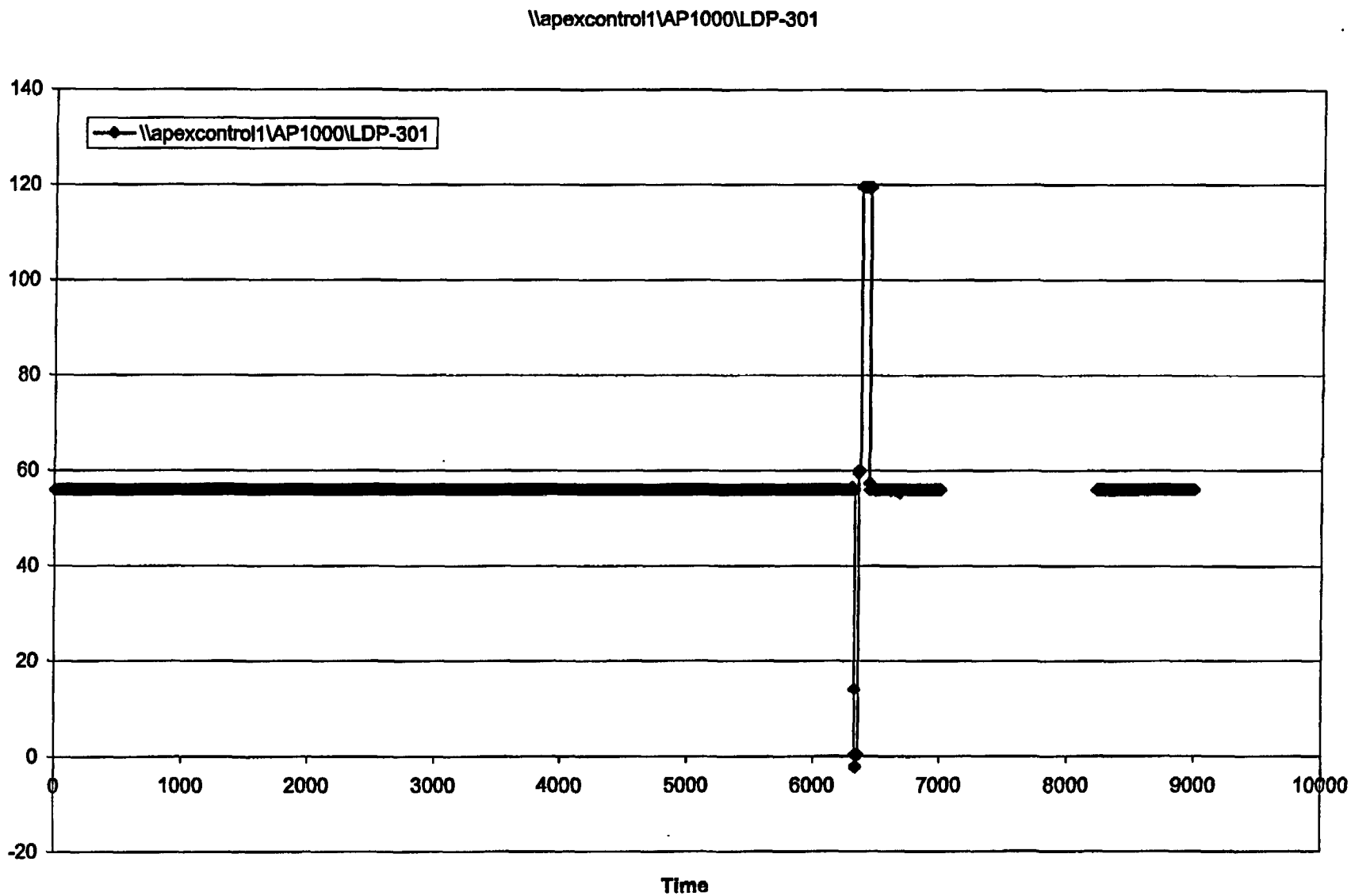

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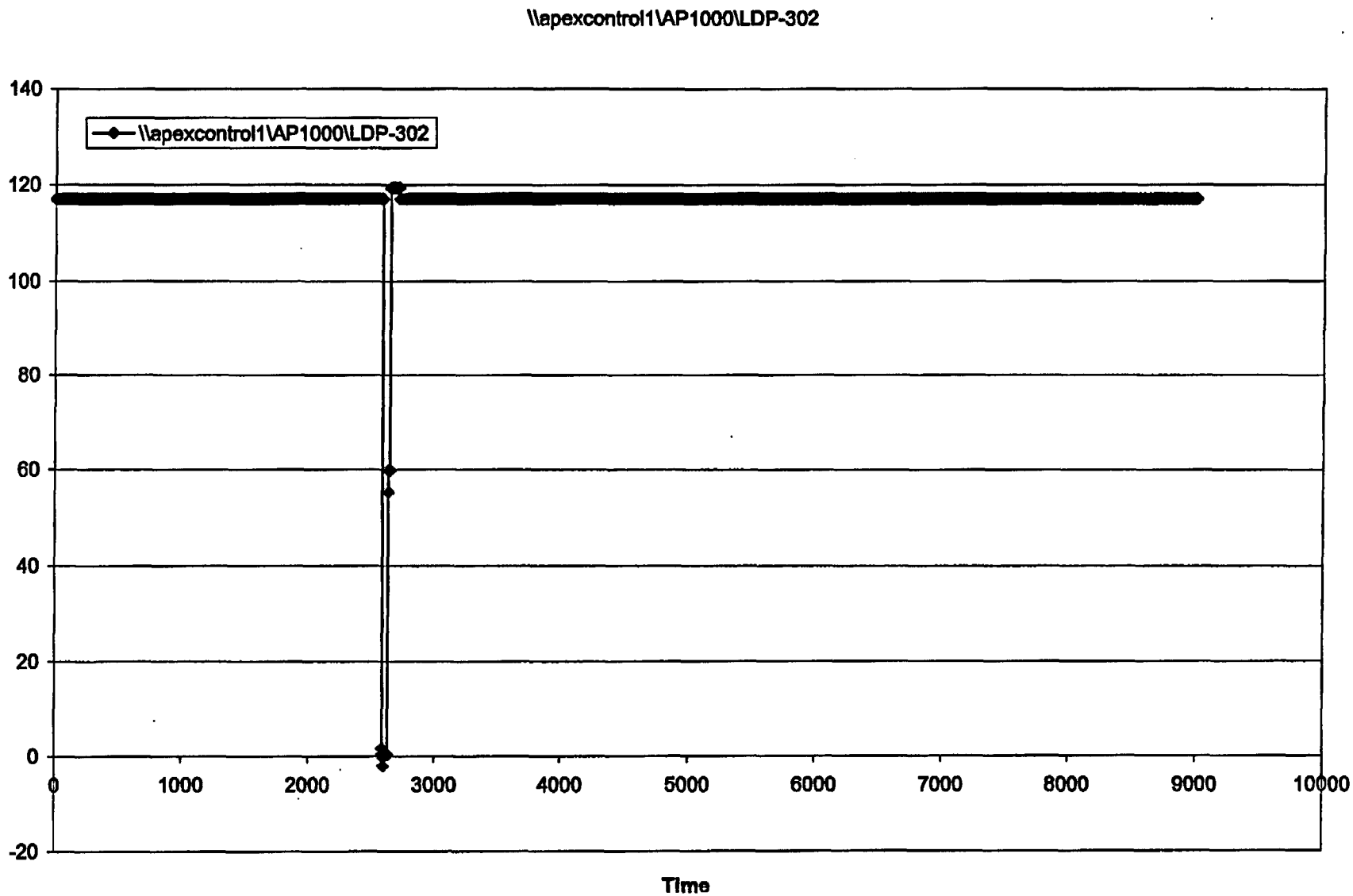

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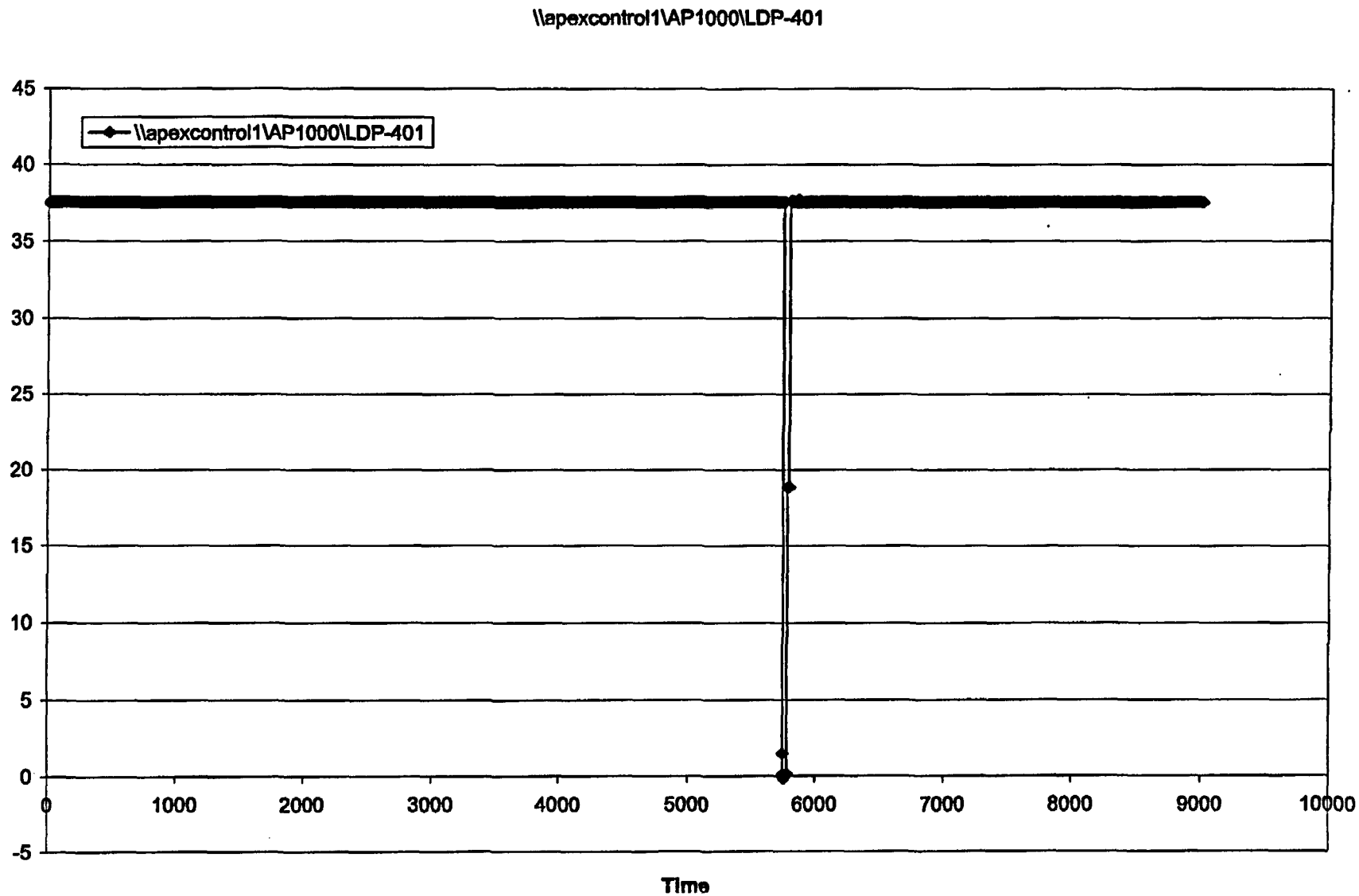

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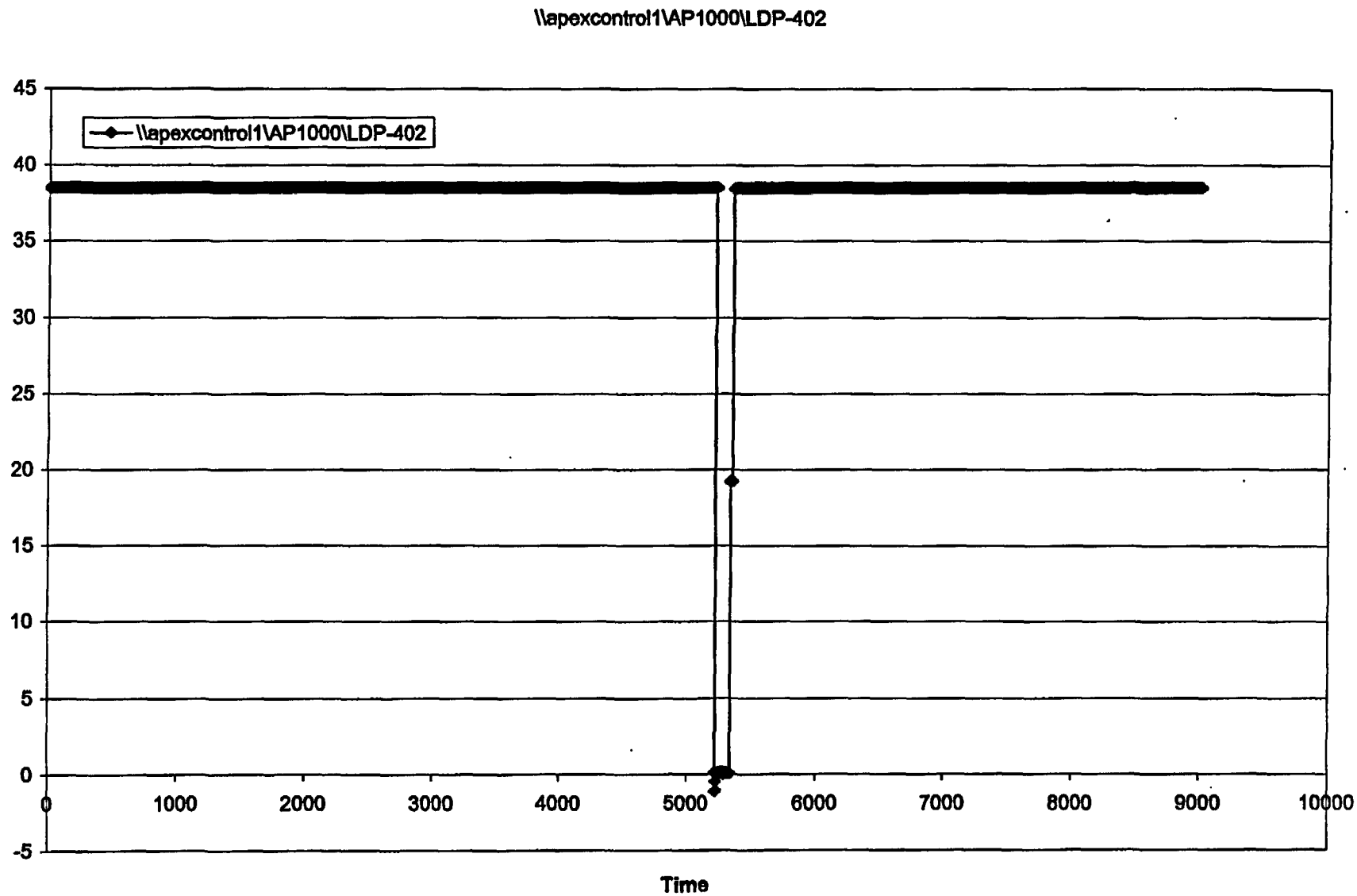

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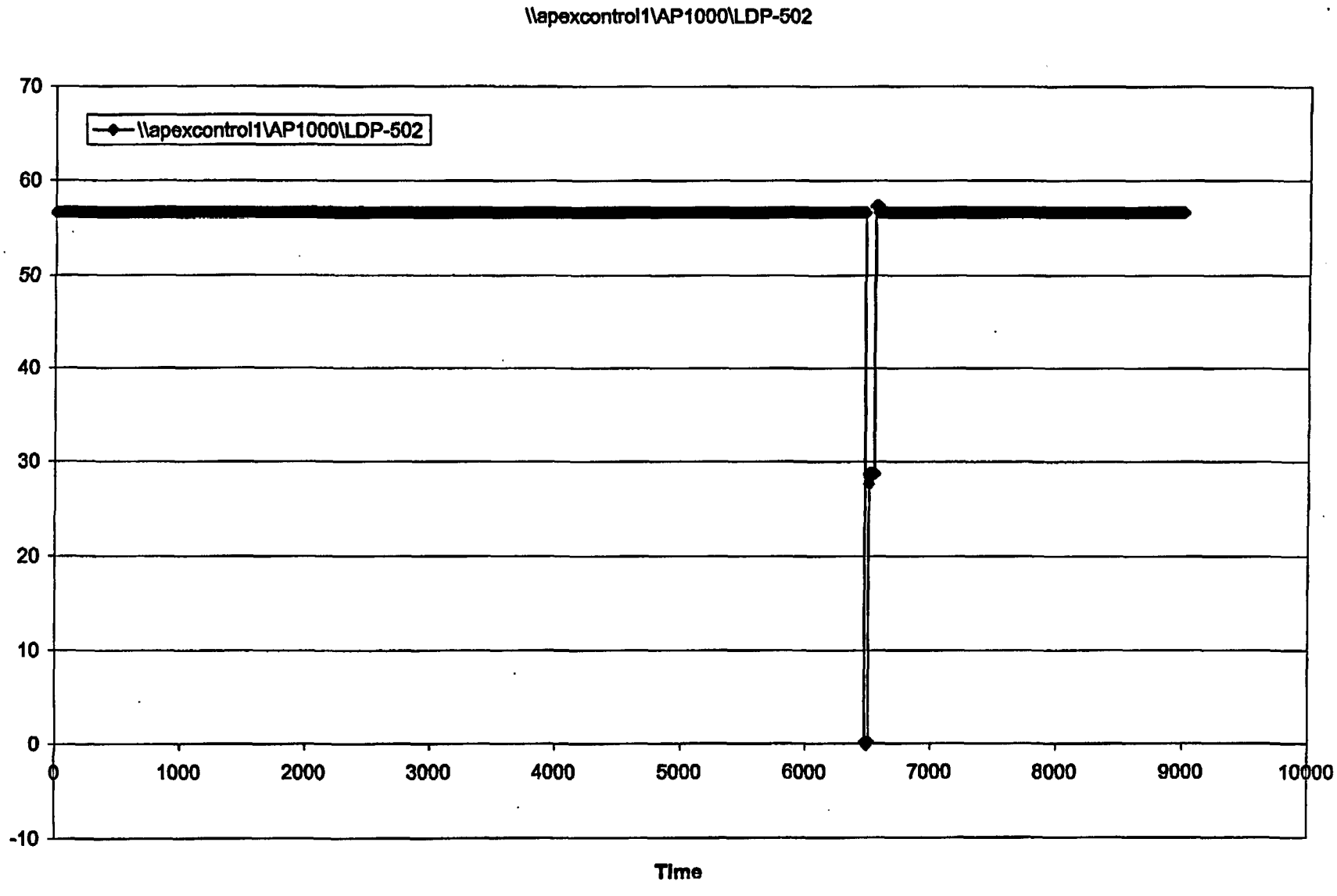

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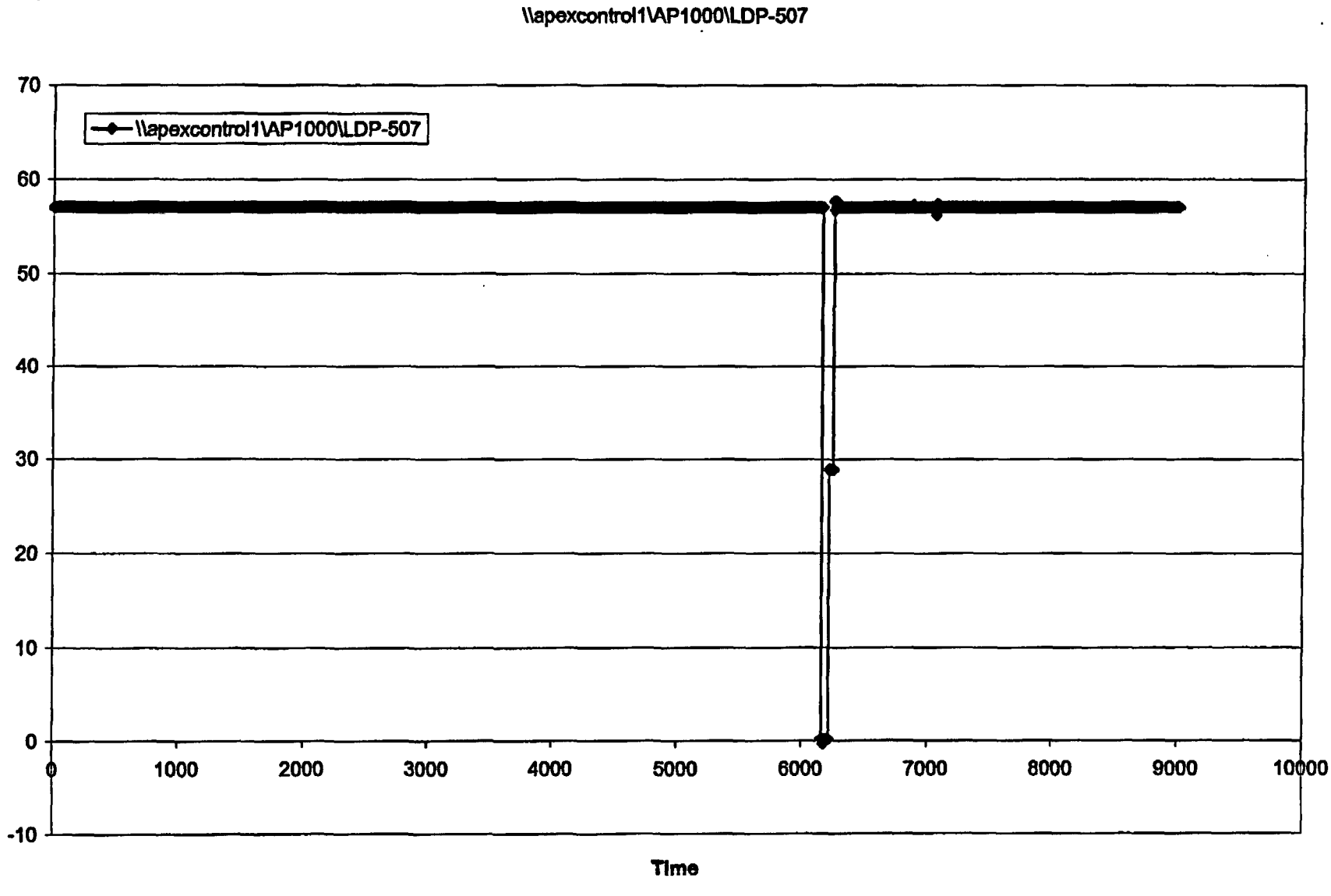

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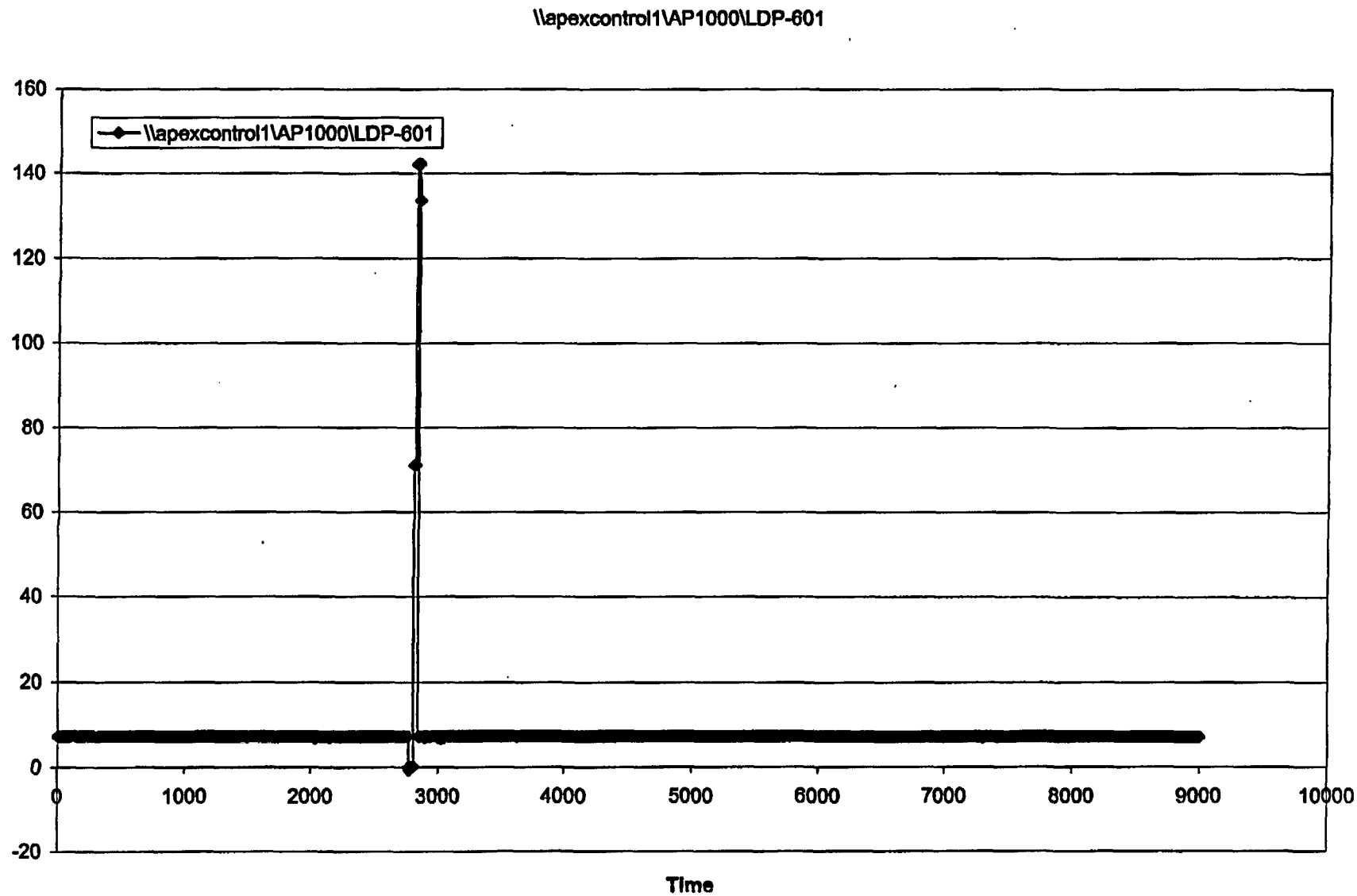

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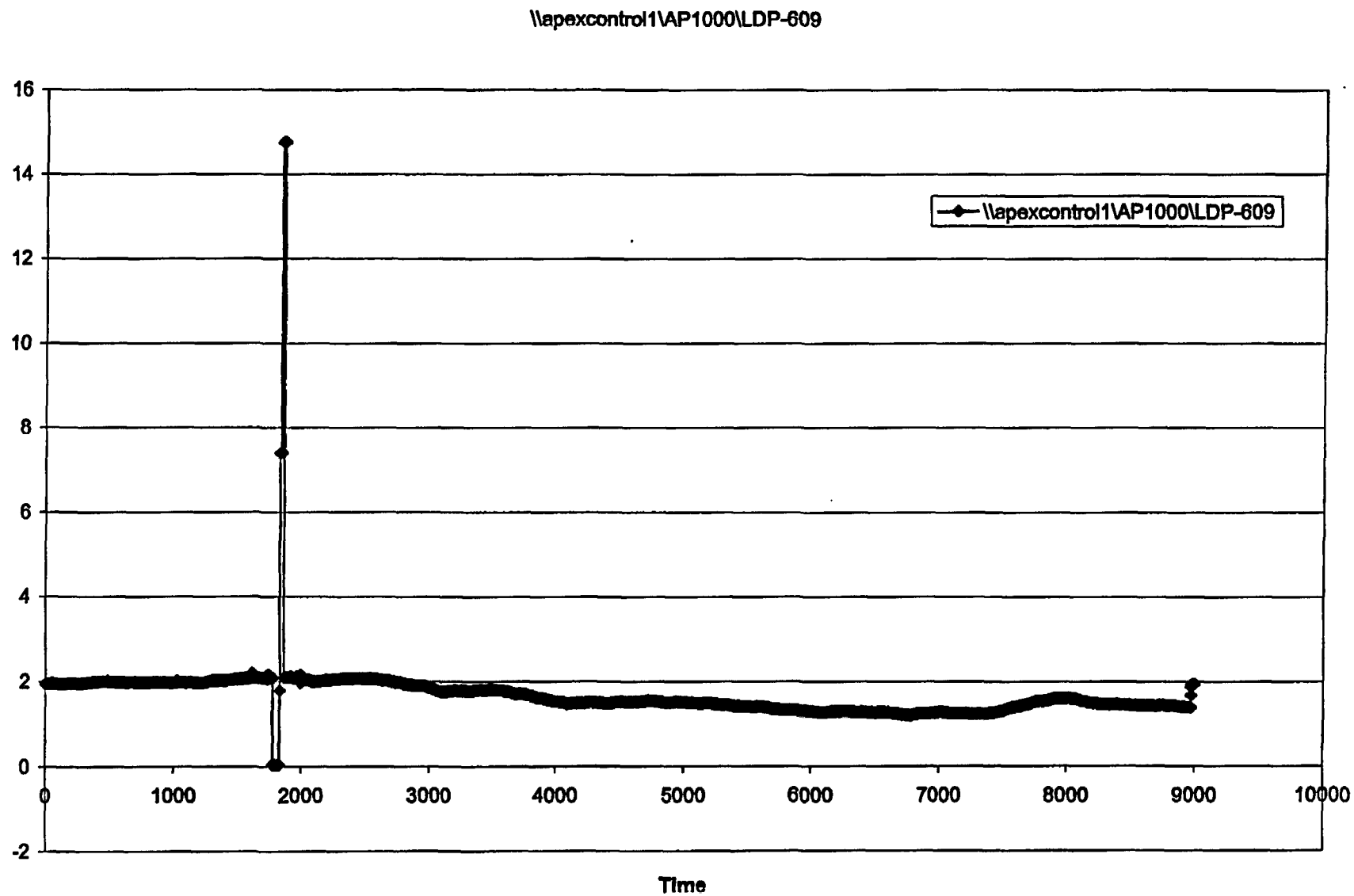

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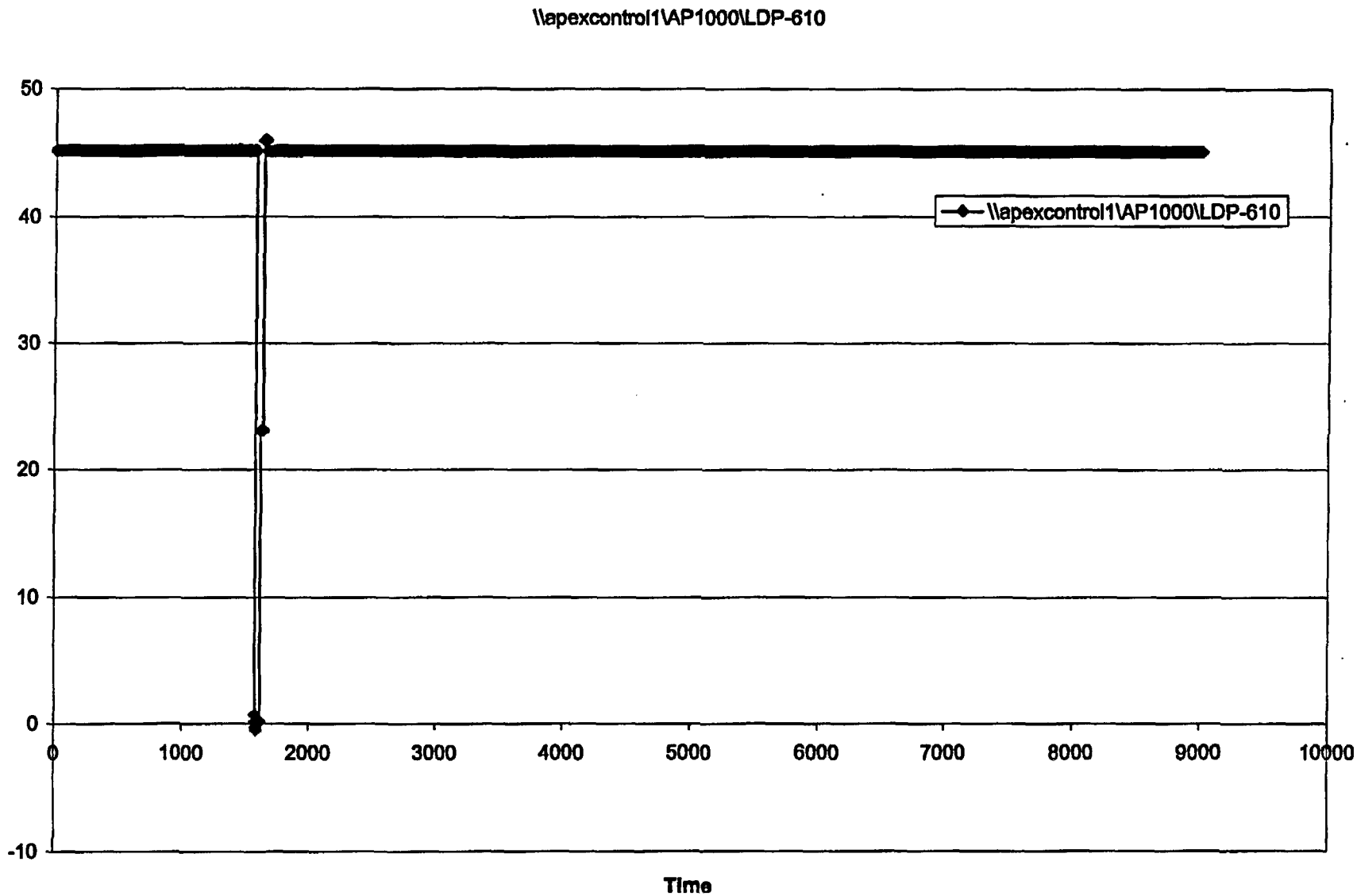

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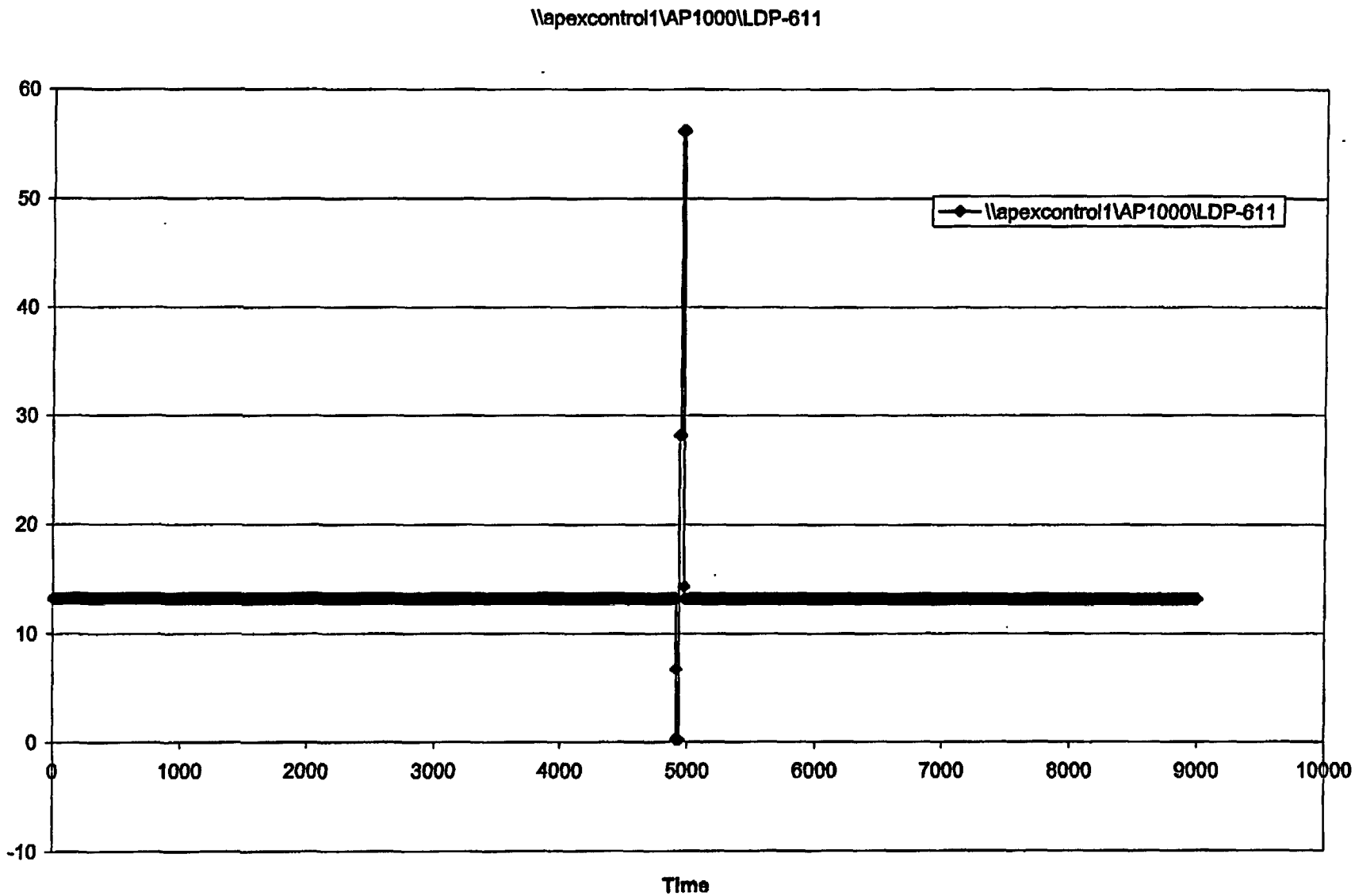

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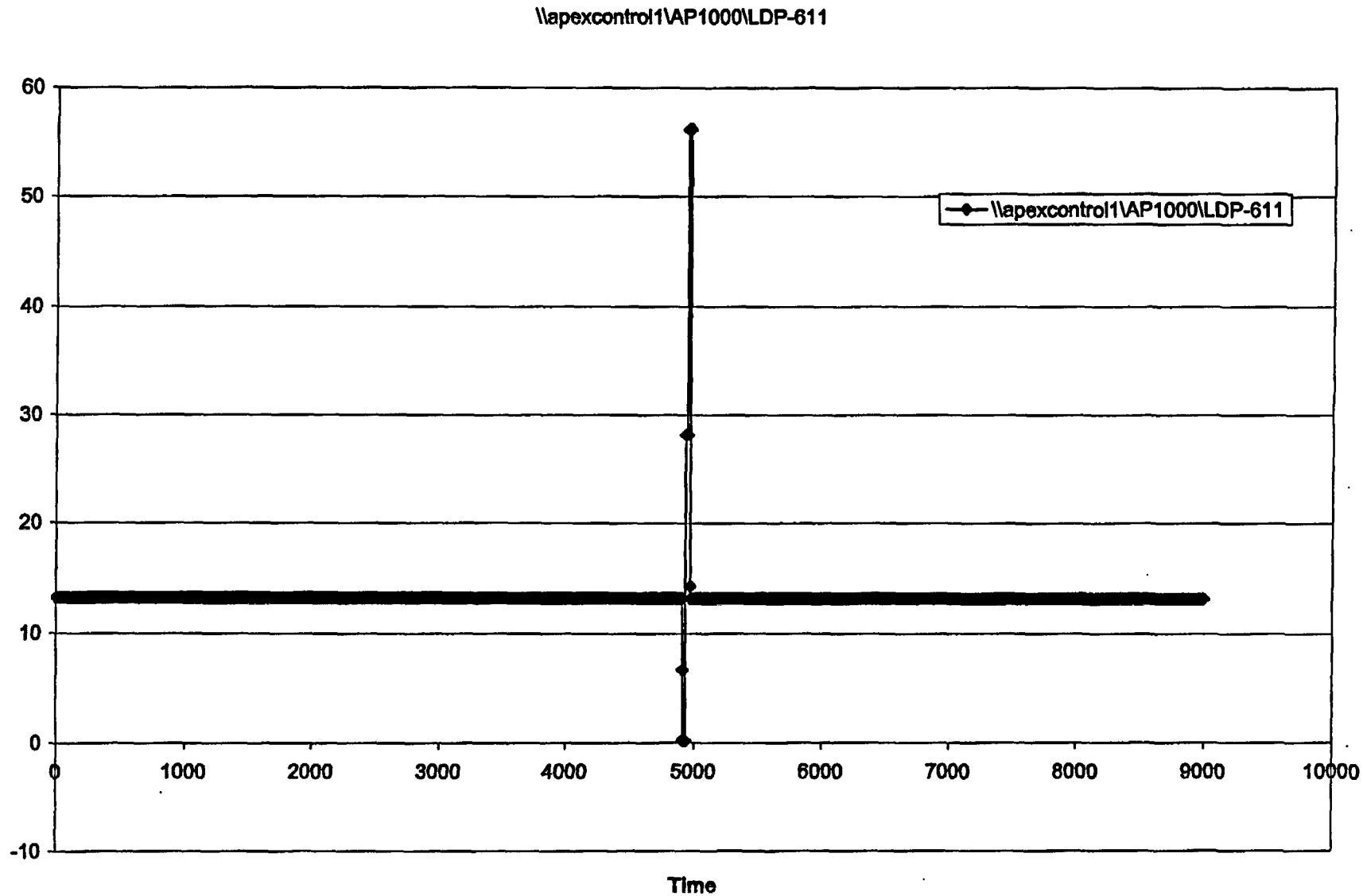

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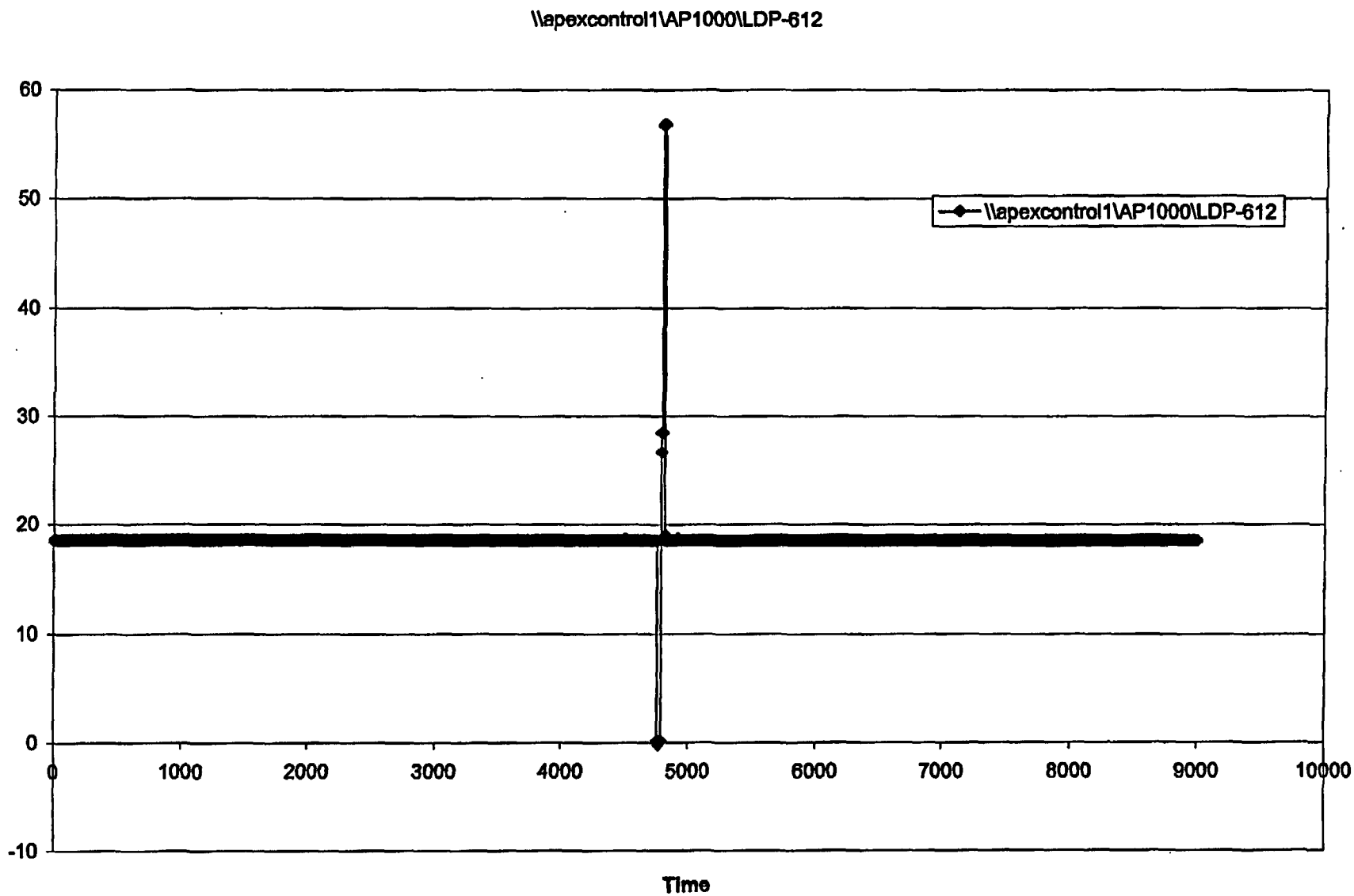

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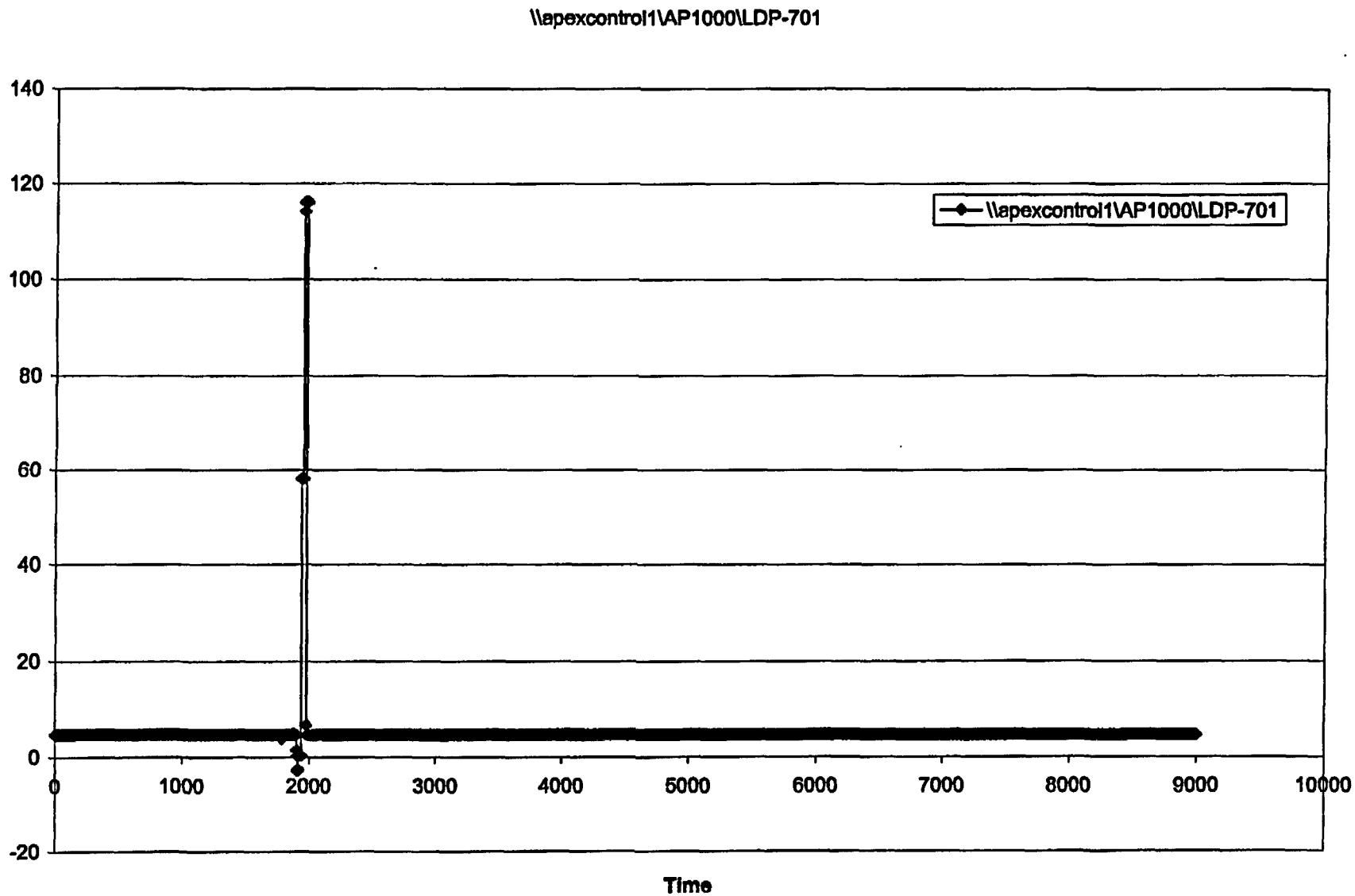

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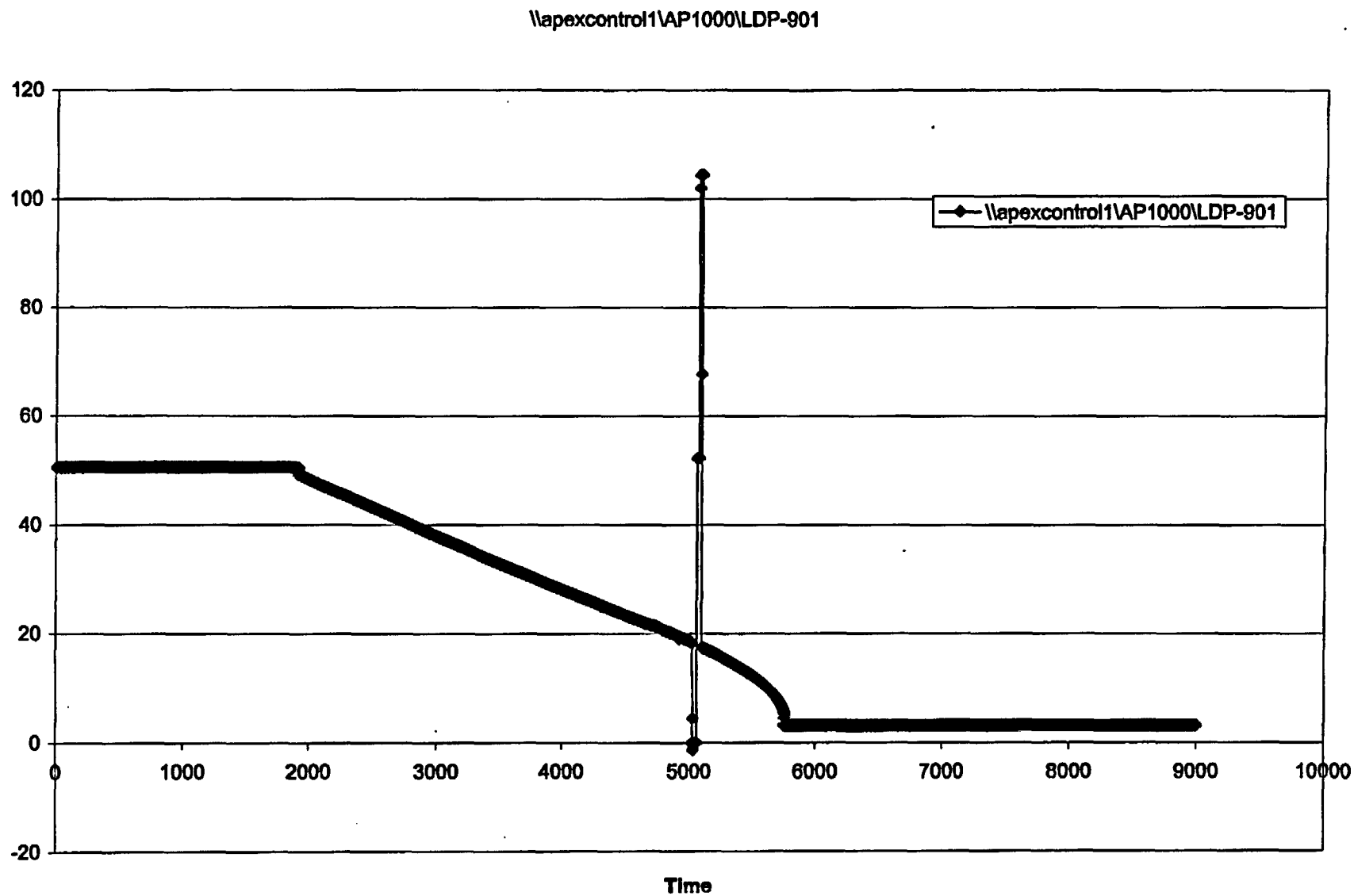

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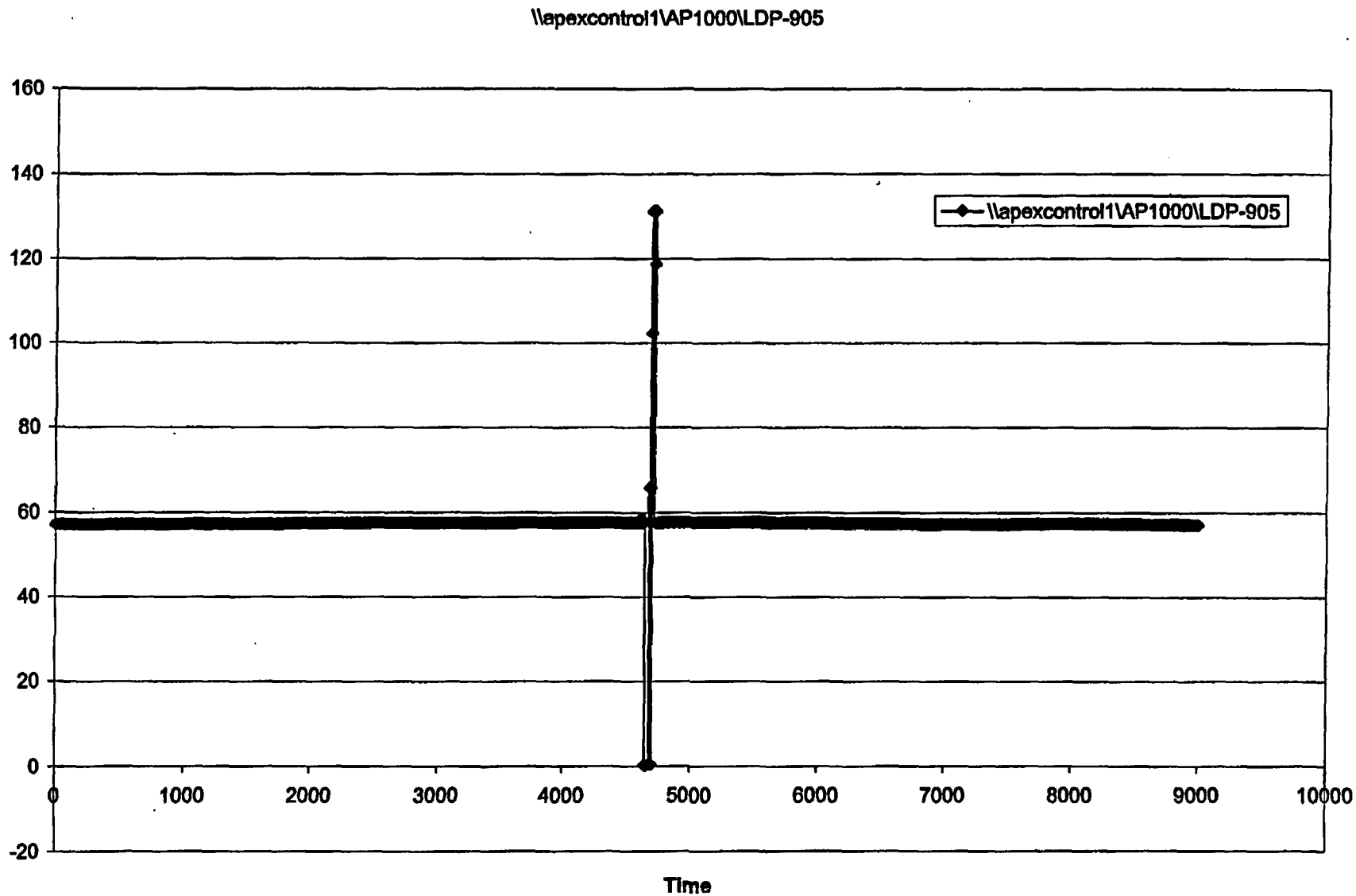

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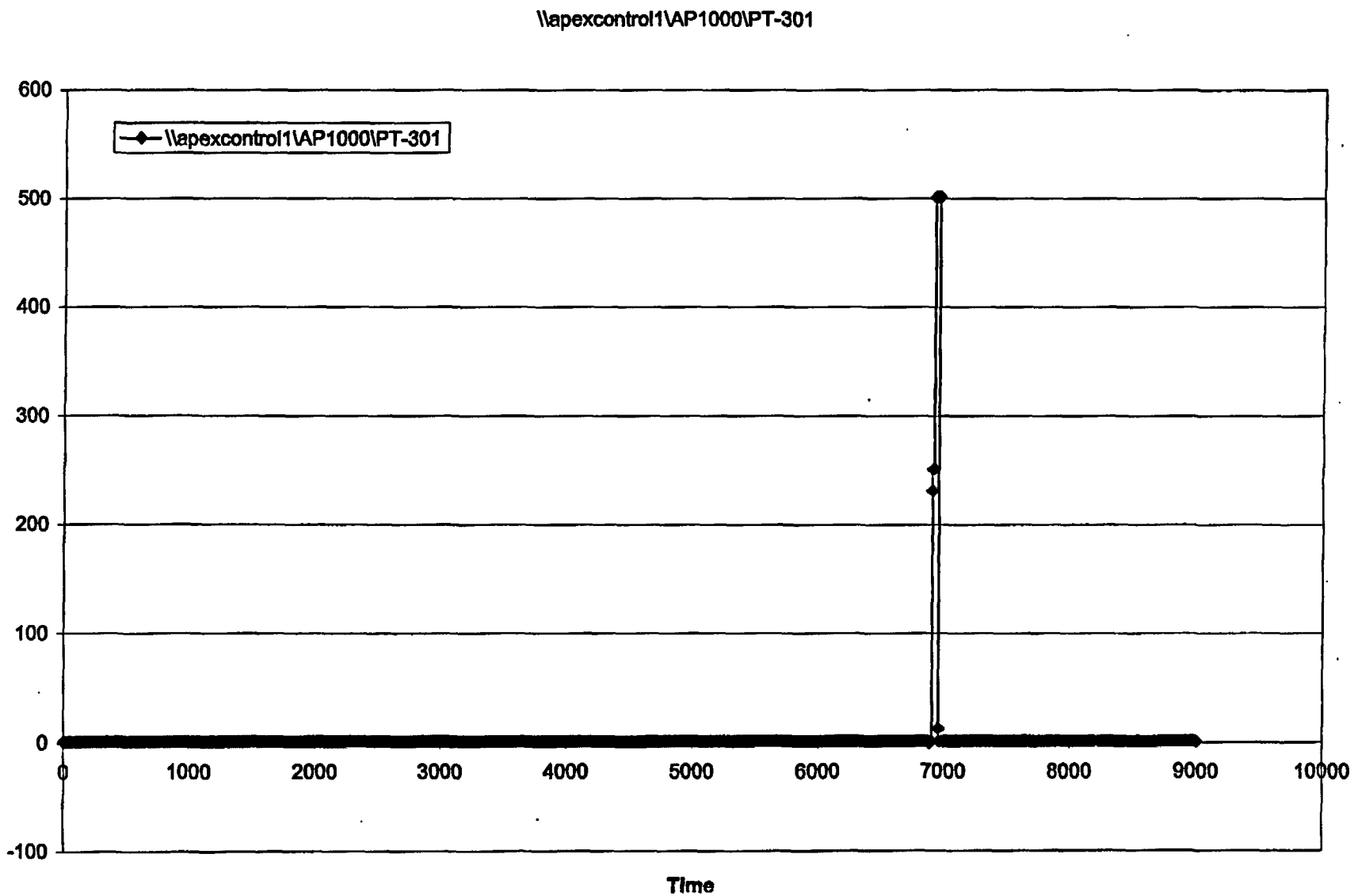

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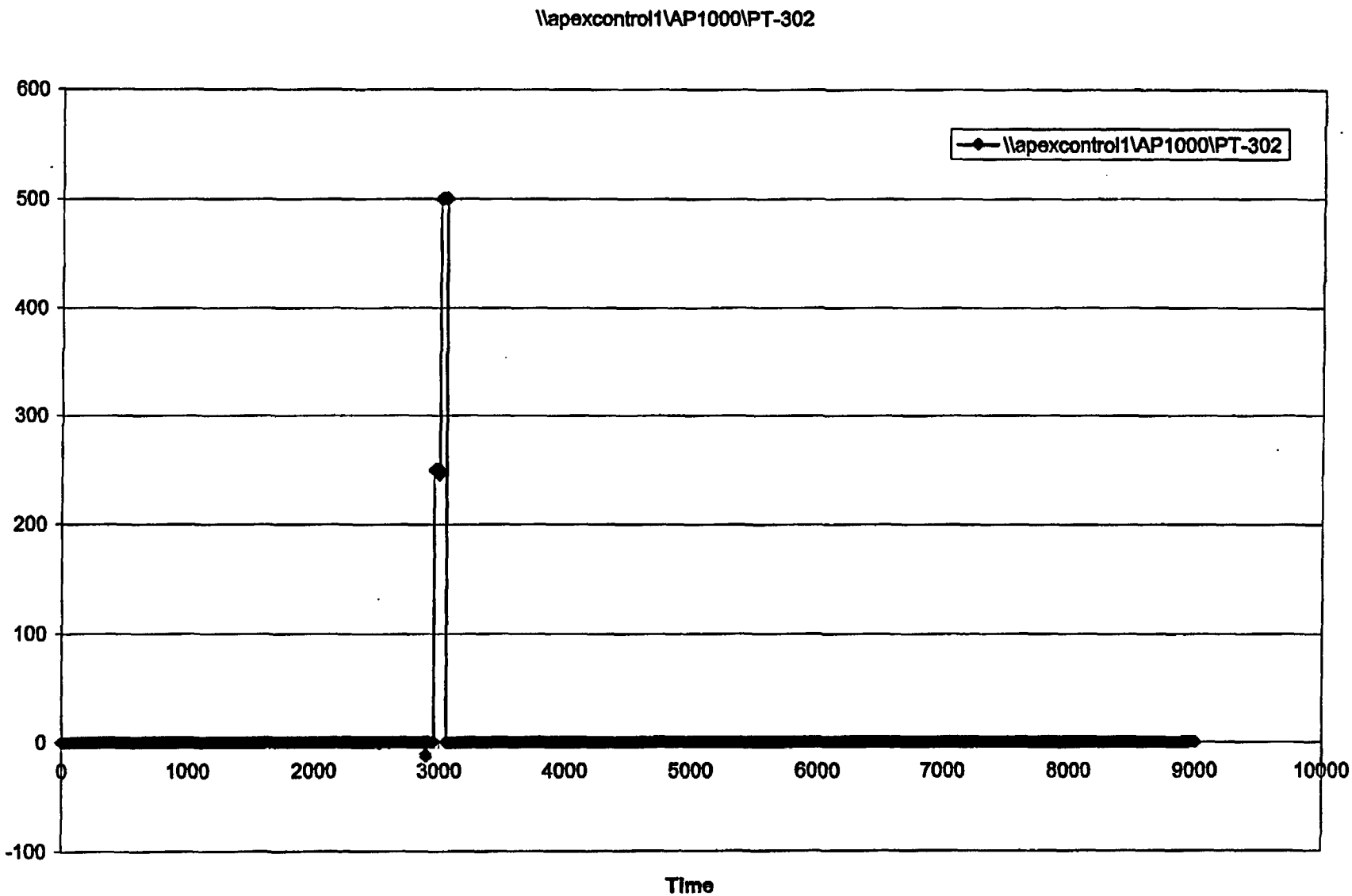

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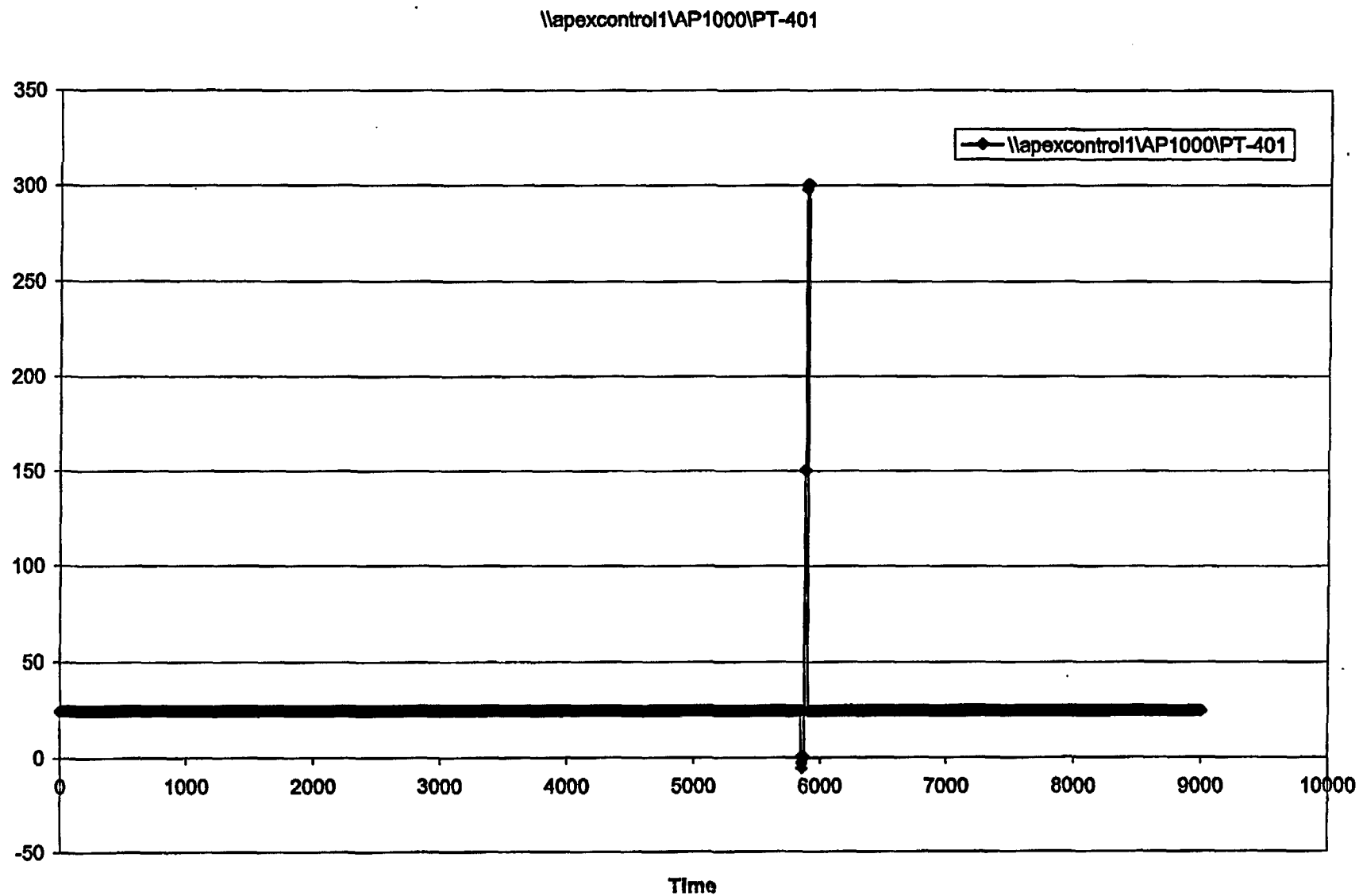

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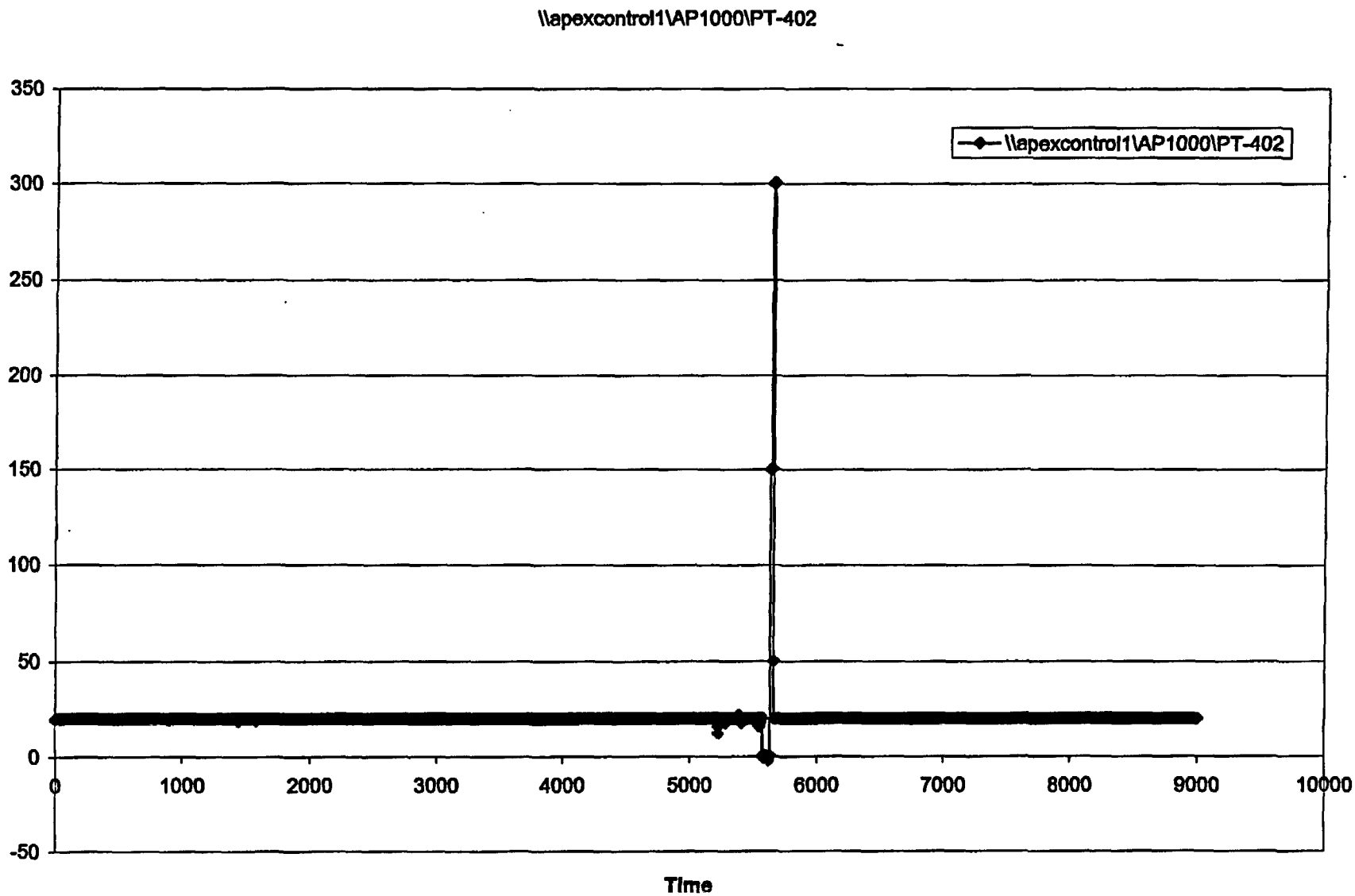

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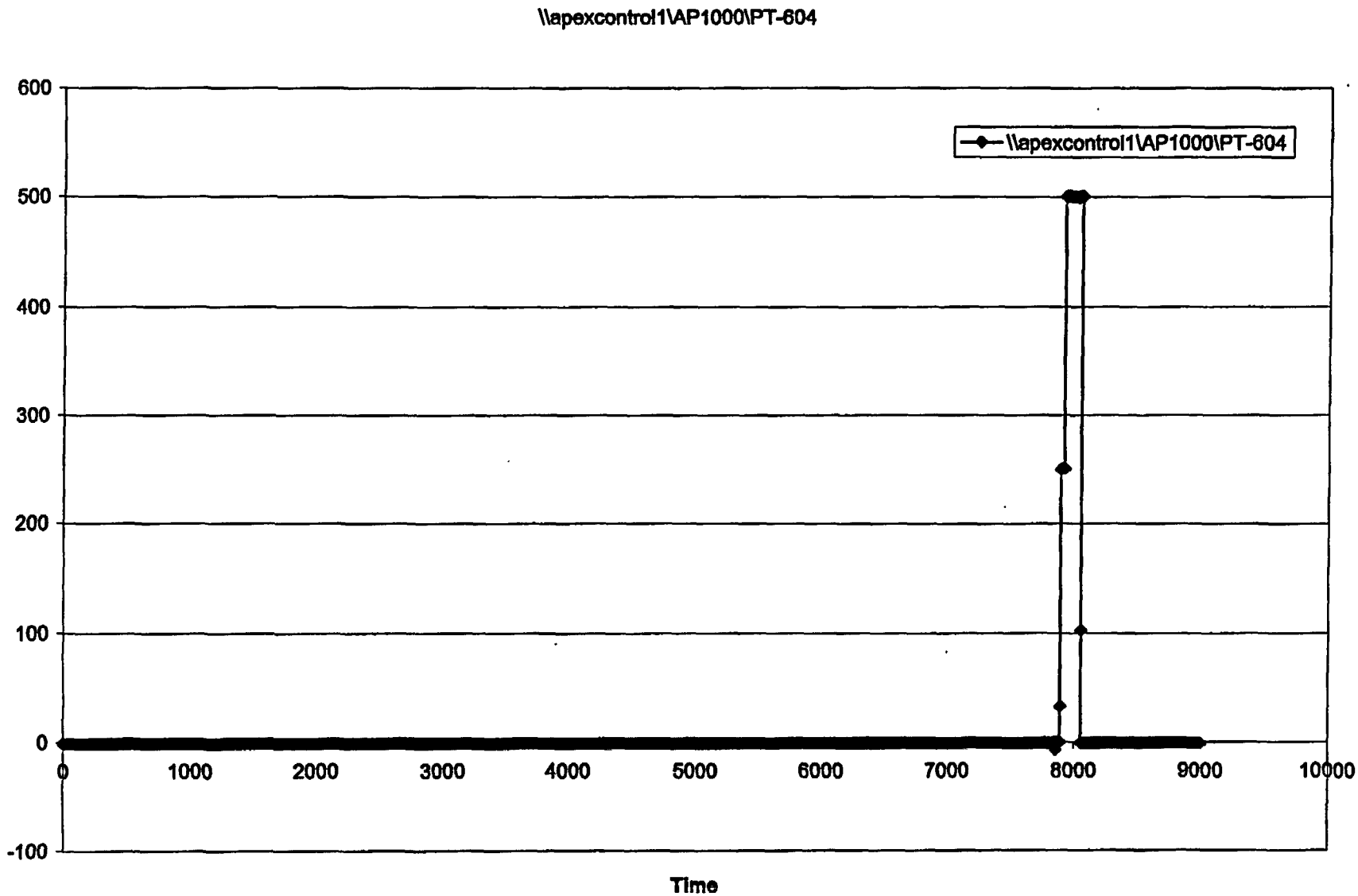

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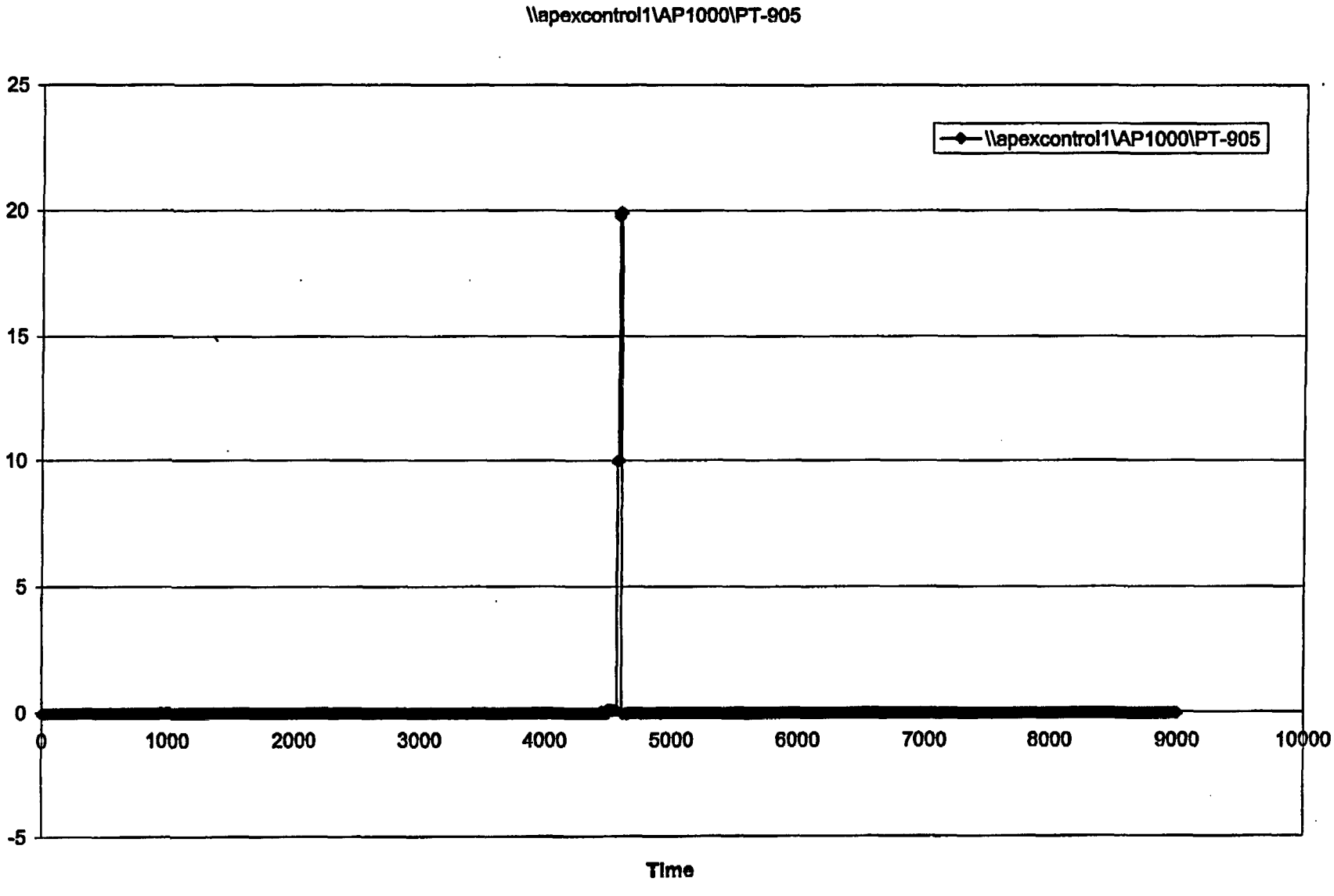

OREGON STATE UNIVERSITY

DEPARTMENT OF NUCLEAR ENGINEERING
AND
RADIATION HEALTH PHYSICS

ADVANCED THERMAL HYDRAULIC RESEARCH LABORATORY

OSU-D-04

AP1000 THERMOCOUPLE FUNCTIONAL CHECK PROCEDURE

Revision 0

Submitted by: 4/04/03
John Hopson — Date
Research Assistant

Reviewed by: 4/04/03
John Groome — Date
Facility Operating Manager
Research Assistant

Approved by: 4/04/03
José N. Reyes, Jr. — Date
OSU Program Manager
Professor

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1.0 OBJECTIVES

The objective of this procedure is to functionally check the operation of the Data Acquisition System and Data Historian for instrumentation monitoring plant thermal characteristics.

To verify that the thermal couple channels have been properly wired and configured to the DAS, and the Data Historian correctly responses: a millivolt (mV) signal will be inserted at the first field I/O junction. To insert a test signal, the m/V source test leads will momentarily placed on the appropriate terminations and the DAS operator will verify a corresponding response by the DAS and the Data Historian. Additionally the plant will be operated at a steady state condition to verify correct anticipated response of the thermocouple, DAS and Data Historian.

2.0 REFERENCES

2.1 The following OSU P&IDs are referenced:

OSU 600LEG	Sheet 1 of 2	Rev 6
OSU 600LEG	Sheet 2 of 2	Rev 7
OSU 600002	Sheet 1 of 2	Rev 11
OSU 600002	Sheet 2 of 2	Rev 43
OSU 600007	Sheet 1 of 1	Rev 4
OSU 600008	Sheet 1 of 2	Rev 4
OSU 600101	Sheet 1 of 2	Rev 6
OSU 600101	Sheet 2 of 2	Rev 4
OSU 600203	Sheet 1 of 1	Rev 11
OSU 600206	Sheet 1 of 1	Rev 10
OSU 600301	Sheet 1 of 1	Rev 10
OSU 600501	Sheet 1 of 1	Rev 6
OSU 600502	Sheet 1 of 1	Rev 6
OSU 600701	Sheet 1 of 1	Rev 8
OSU 600901	Sheet 1 of 1	Rev 6
OSU 600902	Sheet 1 of 1	Rev 3
OSU 600903	Sheet 1 of 1	Rev 3
OSU 600904	Sheet 1 of 1	Rev 1

2.2 The following OSU/APEX Test Facility Logic Drawings:

OSU 500800	Sheet 1 of 3	Rev 0
OSU 500801	Sheet 1 of 20	Rev 6
OSU 500801	Sheet 2 of 20	Rev 4
OSU 500801	Sheet 3 of 20	Rev 5
OSU 500801	Sheet 4 of 20	Rev 6.1
OSU 500801	Sheet 5 of 20	Rev 6
OSU 500801	Sheet 6 of 20	Rev 4
OSU 500801	Sheet 7 of 20	Rev 5
OSU 500801	Sheet 8 of 20	Rev 6
OSU 500801	Sheet 9 of 20	Rev 6
OSU 500801	Sheet 10 of 20	Rev 5
OSU 500801	Sheet 11 of 20	Rev 5
OSU 500801	Sheet 12 of 20	Rev 4
OSU 500801	Sheet 13 of 20	Rev 6
OSU 500801	Sheet 14 of 20	Rev 6
OSU 500801	Sheet 15 of 20	Rev 6.1

OSU 500801	Sheet 16 of 20	Rev 6.1
OSU 500801	Sheet 17 of 20	Rev 6
OSU 500801	Sheet 18 of 20	Rev 6
OSU 500801	Sheet 19 of 20	Rev 6
OSU 500801	Sheet 20 of 20	Rev 5

2.3 Setpoint Document, OSU-E-02, OSU-APEX-94010, Revision 2.

2.4 OSU/APEX Instrumentation Database, Revision 6, Pages 1 through 16.

2.5 Administrative Procedure A-05, Testing Administration, Revision ~~X~~ 2 JHS 5/16/03

2.6 ATHRL Quality Plan, Revision 2.

3.0 PREREQUISITES

STEP 3.1 ☒ Verify all thermocouples are installed and wiring to DAS is complete.

STEP 3.2 ☒ Verify DAS is operational and Data Historian is available to log data channels.

STEP 3.3 ☒ Perform pre-test brief.

4.0 THERMOCOUPLE WIRING VERIFICATION CHECK

NOTE: To verify that the thermal couple channels have been properly wired and configured to the DAS, and the Data Historian correctly responses; a millivolt (mV) signal will be inserted at the first field I/O junction. To insert a test signal, the mV source test leads will momentarily placed on the appropriate terminations and the DAS operator will verify a corresponding response by the DAS and the Data Historian.

STEP 4.1 ☒ Obtain a Tegam 840A or equivalent thermocouple simulator.

STEP 4.2 ☒ Configure DAS to log all thermocouple channels identified on Appendix A at a scan rate of 1 second.

STEP 4.3 ☒ Start the Data Historian. Launch RealTime server and historical trend application.

STEP 4.4 ☒ Set the thermocouple simulator to simulate a Type K thermocouple at 400°F.

NOTE: When simulating 400°F, the DAS and Data Historian will see a value other than the simulated temperature because this signal is being imposed on top of ambient temperature (i.e. leads are not being lifted during the simulation.)

STEP 4.5 ☒ For each thermocouple listed on Appendix A; place the thermocouple (yellow +, red -) on each field I/O termination point and record DAS response on Appendix A. At this time also record the thermocouple landing points on Appendix A

STEP 4.6 ☒ Confirm historical trend shows correct response and that the data point was saved to disk.

STEP 4.7 ☒ Record results/discrepancies on Appendix A.

5.0 THERMOCOUPLE RESPONSE TEST (SINGLE POINT TEST)

NOTE: To the extent possible, thermocouple responses will be verified with the test facility in a higher than ambient plant steady state condition. Data will be collected, plotted and compared to data from ambient.

STEP 5.1 ☒ For thermocouple listed in Appendix A, configure the DAS to log data every second.

STEP 5.2 ☑ Start the Data Historian and log for approximately 2 minutes to obtain baseline ambient temperature.

STEP 5.3 ☒ Fill and heat up the APEX Test Facility per .

STEP 5.4 ☑ After steady state conditions have been achieved secure data logging and review data for proper for proper response. Record results/discrepancies on Appendix A.

Test Engineer Signature _____ Date 5/16/03

6.0 ACCEPTANCE CRITERIA

STEP 6.1 ☒ Thermocouple wiring has been confirmed and appropriate response signal has been logged and verified at the DAS and Data Historian.

STEP 6.2 ☒ Thermocouple response test results are documented as Appendix B and any discrepancies are resolved to document out-of-calibration thermocouples.

A JHS 4/11/03

ACCEPTANCE CRITERIA MET

J. L. Schlamar — J. L. Schlamar — 5/16/03

Test Engineer Name — Test Engineer Signature — Date

TEST LOG

Procedure Number: OSU-D-04 Rev.: 0

Test Engineer: J.L. Schlaman Date: 4/4/03

Time	Comments
1300	Commenced Thermal Couple Testing.
	Test Engineer J.L. Schlaman assisted by
	J. Hopson, T. Culver and J. Skinner
	Pre Test briefing was conducted outlining
	the Test methodology and the plant
	equipment responses that could be expected
	The Test is expected to take several Days
	and Descrepancies will be noted on
	Appendix A and then summerized in
	the Test Log
	The following minor corrections were made
	to the procedure Section 2.5 Revision 1
	changed to Revision 2. Section 6.2
	Appendix B changed to Appendix A.
1500	Secured Testing for the Day
0900	4/7/03 Commenced testing
1800	Secured Testing for the Day
1300	4/8/03 Commenced Testing
1800	Secured Testing for the Day
1300	4/9/03 Commenced Testing
1800	Secured Testing for Day

TEST LOG

Procedure Number: OSU-D-04 Rev.: 0

Test Engineer: J.L. Schlaman Date: 4/10/03

Time	Comments
1300	4/10/03 Commenced Testing
1800	Secured testing for the Day
0900	4/11/03 Commenced Testing
1200	Secured testing for the Day
0900	4/14/03 Commenced testing
1800	Secured testing for the Day
1300	4/17/03 Commenced testing
1800	Secured testing for Day
1400	4/21/03 Commenced testing
1800	Secured testing for Day
1300	4/23/03 Commenced testing
1800	Secured Testing for Day
0900	4/24/03 Commenced testing
1600	Secured testing for Day
0900	5/29/03 Commenced testing
1800	Secured testing for Day
1300	5/30/03 Commenced testing
1500	Secured testing for Day

TEST LOG

Procedure Number: OSU-D-04 Rev.: 0

Test Engineer: J.L. Schleman Date: 5/1/03

Time	Comments
1500	5/1/03 OSU-AP-1000-03 was run and the data obtained was used to verify proper response of the thermal couples. The results were recorded in Appendix A
1800	Secured testing for the day
0900	5/6/03 The following is a summary of the discrepancies noted on Appendix A
	The following thermal couples are considered OOC
	TF-170, TF-171, TF-172, TF-221, TF-509 TF-512, TW-202, TW-204, TW-205, TW-206 TW-209, TW-210, TW-803 and TW-804
	TH-603 changed wiring from chassis 1 card 10 channel 12 to chassis 1 card 10 channel 28 due to bad connection

TEST LOG

Procedure Number: DSL-0-04 Rev.: 0

Test Engineer: J. L. Schlamar Date: 5/16/03

Time	Comments
	TF-231 wired red to yellow and yellow to red. DAS response is correct.
	TF-229 wired red to yellow and yellow to red, DAS response is correct
	The following thermal couple wires are not labeled in the Junction Boxes
	TF-009 TF-010 TF-222 TF-223 TF-224
	TF-225 TF-226 TF-227 TF-228 TF-229
	TF-230, TF-231 TF-232 TF-512 TF-617
	TF-719
	The following thermal couples were
	labeled incorrectly
	TH-103 labeled TC-103
	TH-211 labeled TC-211
	TH-305 labeled TC-305
	TH-309 labeled TC-309
	TH-401 labeled TC-401
	TH-507 labeled TC-507

TEST LOG

Procedure Number: QSW-0-04 Rev.: 0

Test Engineer: J.L. Schlaman Date: 5/16/04

Time	Comments
	Appendix A Table TF-104-4D-2.5 was corrected to read TF-104-4D-2.6 wires were also labeled TF-104-4D-2.5
	Temporary tag were installed on all wiring inconsistances until permanent heat shrink labels could be obtained
	No further Test entries
	J.L. Schlaman
	J.L. Schlaman 5/16/04

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-005	WM				☒	Dev1 SC1 MD4	4	☒	☒	☒
TF-006	WM				☒	Dev1 SC1 MD4	5	☒	☒	☒
TF-007	WM				☒	Dev1 SC1 MD4	6	☒	☒	☒
TF-009	28	2	1	2	Not Labeled ☐	Dev1 SC2 MD3	14	☒	☒	☒
TF-010	28	2	4	5	Not Labeled ☐	Dev1 SC2 MD3	15	☒	☒	☒
TF-101	2	1	19	20	☒	Dev2 SC3 MD11	0	☒	☒	☒
TF-101-2D-1	30	1	3	4	☒	Dev1 SC2 MD5	21	☒	☒	☒
TF-101-2D-2	30	1	5	6	☒	Dev1 SC2 MD5	22	☒	☒	☒
TF-101-2D-3	30	1	7	8	☒	Dev1 SC2 MD5	23	☒	☒	☒
TF-101-3D-1	30	1	9	10	☒	Dev1 SC2 MD5	24	☒	☒	☒
TF-101-3D-2	30	1	11	12	☒	Dev1 SC2 MD5	25	☒	☒	☒
TF-101-3D-3	30	1	13	14	☒	Dev1 SC2 MD5	26	☒	☒	☒
TF-101-4D-1	30	1	15	16	☒	Dev1 SC2 MD5	27	☒	☒	☒
TF-101-4D-2	30	1	17	18	☒	Dev1 SC2 MD5	28	☒	☒	☒
TF-101-8D-1	30	1	19	20	☒	Dev1 SC2 MD5	29	☒	☒	☒
TF-101-8D-2	30	1	21	22	☒	Dev1 SC2 MD5	30	☒	☒	☒
TF-102	2	1	21	22	☒	Dev2 SC3 MD11	1	☒	☒	☒
TF-102-1.3D-2	30	1	23	24	☒	Dev1 SC2 MD5	31	☒	☒	☒
TF-102-2D-1	30	1	25	26	☒	Dev1 SC2 MD6	0	☒	☒	☒

J. L. Schlamm 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-102-2D-2	30	1	27	28	☒	Dev1 SC2 MD6	1	☒	☒	☒
TF-102-2D-3	30	1	29	30	☒	Dev1 SC2 MD6	2	☒	☒	☒
TF-102-3D-1	30	1	31	32	☒	Dev1 SC2 MD6	3	☒	☒	☒
TF-102-3D-2	30	1	33	34	☒	Dev1 SC2 MD6	4	☒	☒	☒
TF-102-3D-3	30	1	35	36	☒	Dev1 SC2 MD6	5	☒	☒	☒
TF-102-4D-2	30	1	37	38	☒	Dev1 SC2 MD6	6	☒	☒	☒
TF-102-8D-1	30	1	39	40	☒	Dev1 SC2 MD6	7	☒	☒	☒
TF-102-8D-2	30	2	1	2	☒	Dev1 SC2 MD6	8	☒	☒	☒
TF-103-1.3D-2	30	2	3	4	☒	Dev1 SC2 MD6	9	☒	☒	☒
TF-103-2D-1	30	2	5	6	☒	Dev1 SC2 MD6	10	☒	☒	☒
TF-103-2D-2	30	2	7	8	☒	Dev1 SC2 MD6	11	☒	☒	☒
TF-103-2D-3	30	2	9	10	☒	Dev1 SC2 MD6	12	☒	☒	☒
TF-103-3D-1	30	2	11	12	☒	Dev1 SC2 MD6	13	☒	☒	☒
TF-103-3D-2	30	2	13	14	☒	Dev1 SC2 MD6	14	☒	☒	☒
TF-103-3D-3	30	2	15	16	☒	Dev1 SC2 MD6	15	☒	☒	☒
TF-103-4D-2	30	2	17	18	☒	Dev1 SC2 MD6	16	☒	☒	☒
TF-103-8D-1	30	2	19	20	☒	Dev1 SC2 MD6	17	☒	☒	☒
TF-103-8D-2	30	2	21	22	☒	Dev1 SC2 MD6	18	☒	☒	☒
TF-104-1.3D-2	30	2	23	24	☒	Dev1 SC2 MD6	19	☒	☒	☒

J. Schlamm 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-104-1.5D-2	30	3	29	30	☒	Dev1 SC2 MD7	14	☒	☒	☒
TF-104-2D-1	30	2	25	26	☒	Dev1 SC2 MD6	20	☒	☒	☒
TF-104-2D-2	30	2	27	28	☒	Dev1 SC2 MD6	21	☒	☒	☒
TF-104-2D-3	30	2	29	30	☒	Dev1 SC2 MD6	22	☒	☒	☒
TF-104-3.5D-2	30	3	31	32	☒	Dev1 SC2 MD7	15	☒	☒	☒
TF-104-3.5D-3	30	3	33	34	☒	Dev1 SC2 MD7	16	☒	☒	☒
TF-104-3D-1	30	2	31	32	☒	Dev1 SC2 MD6	23	☒	☒	☒
TF-104-3D-1.5	30	3	35	36	☒	Dev1 SC2 MD7	17	☒	☒	☒
TF-104-3D-2	30	2	33	34	☒	Dev1 SC2 MD6	24	☒	☒	☒
TF-104-3D-2.5	30	3	37	38	☒	Dev1 SC2 MD7	18	☒	☒	☒
TF-104-3D-3	30	2	35	36	☒	Dev1 SC2 MD6	25	☒	☒	☒
TF-104-4D-1	30	2	37	38	☒	Dev1 SC2 MD6	26	☒	☒	☒
TF-104-4D-1.3	30	3	39	40	☒	Dev1 SC2 MD7	19	☒	☒	☒
TF-104-4D-1.6	30	4	1	2	☒	Dev1 SC2 MD5	0	☒	☒	☒
TF-104-4D-2	30	2	39	40	☒	Dev1 SC2 MD6	27	☒	☒	☒
TF-104-4D-2.3	30	4	3	4	☒	Dev1 SC2 MD5	1	☒	☒	☒
TF-104-4D-2.6	30	4	5	6	Labelled 104-4D-2.5 ☐ Should be 104-4D-2.6	Dev1 SC2 MD5	2	☒	☒	☒
TF-104-8D-1	30	3	1	2	☒	Dev1 SC2 MD7	0	☒	☒	☒
TF-104-8D-1.3	30	4	7	8	☒	Dev1 SC2 MD5	3	☒	☒	☒

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APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-104-8D-1.6	30	4	9	10	☒	Dev1 SC2 MD5	4	☒	☒	☒
TF-104-8D-2	30	3	3	4	☒	Dev1 SC2 MD7	1	☒	☒	☒
TF-104-8D-2.3	30	4	11	12	☒	Dev1 SC2 MD5	5	☒	☒	☒
TF-104-8D-2.6	30	4	13	14	☒	Dev1 SC2 MD5	6	☒	☒	☒
TF-105	1	1	1	2	☒	Dev2 SC3 MD11	2	☒	☒	☒
TF-106	1	1	3	4	☒	Dev2 SC3 MD11	3	☒	☒	☒
TF-107	1	1	5	6	☒	Dev1 SC1 MD1	2	☒	☒	☒
TF-108	1	1	7	8	☒	Dev1 SC1 MD1	3	☒	☒	☒
TF-113	2	1	27	28	☒	Dev1 SC1 MD1	4	☒	☒	☒
TF-114	1	1	9	10	☒	Dev1 SC1 MD1	5	☒	☒	☒
TF-115	2	1	29	30	☒	Dev1 SC1 MD1	6	☒	☒	☒
TF-116	1	1	11	12	☒	Dev1 SC1 MD1	7	☒	☒	☒
TF-118	2	5	7	8	☒	Dev1 SC1 MD4	8	☒	☒	☒
TF-120	12	4	22	23	☒	Dev1 SC1 MD4	9	☒	☒	☒
TF-126	1	5	26	27	☒	Dev1 SC1 MD1	8	☒	☒	☒
TF-127	2	5	15	16	☒	Dev1 SC1 MD1	9	☒	☒	☒
TF-128	2	5	13	14	☒	Dev1 SC1 MD4	10	☒	☒	☒
TF-129	2	5	11	12	☒	Dev1 SC1 MD4	11	☒	☒	☒
TF-130	2	1	33	34	☒	Dev1 SC1 MD4	12	☒	☒	☒

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APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-131	2	1	35	36	☒	Dev1 SC1 MD4	13	☒	☒	☒
TF-132	2	1	37	38	☒	Dev1 SC1 MD4	14	☒	☒	☒
TF-133	2	1	39	40	☒	Dev1 SC1 MD4	15	☒	☒	☒
TF-134	2	1	41	42	☒	Dev1 SC1 MD4	16	☒	☒	☒
TF-135	2	1	43	44	☒	Dev1 SC1 MD4	17	☒	☒	☒
TF-140	2	2	45	46	☒	Dev2 SC3 MD11	12	☒	☒	☒
TF-141	1	1	13	14	☒	Dev2 SC3 MD11	13	☒	☒	☒
TF-142	1	1	15	16	☒	Dev1 SC1 MD1	10	☒	☒	☒
TF-143	2	2	41	42	☒	Dev1 SC1 MD1	11	☒	☒	☒
TF-147	1	1	17	18	☒	Dev1 SC1 MD4	18	☒	☒	☒
TF-148	1	1	19	20	☒	Dev1 SC1 MD4	19	☒	☒	☒
TF-149	1	1	21	22	☒	Dev1 SC1 MD4	20	☒	☒	☒
TF-150	1	2	1	2	☒	Dev1 SC1 MD4	21	☒	☒	☒
TF-151	1	2	3	4	☒	Dev1 SC1 MD4	22	☒	☒	☒
TF-152	1	2	5	6	☒	Dev1 SC1 MD4	23	☒	☒	☒
TF-153	1	2	7	8	☒	Dev1 SC1 MD4	24	☒	☒	☒
TF-154	1	2	9	10	☒	Dev1 SC1 MD4	25	☒	☒	☒
TF-155	1	2	11	12	☒	Dev1 SC1 MD4	26	☒	☒	☒
TF-156	1	5	28	29	☒	Dev1 SC1 MD4	27	☒	☒	☒

J. L. Schlamm 5/16/23

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-157	1	5	30	31	☒	Dev1 SC1 MD5	0	☒	☒	☒
TF-158	1	5	32	33	☒	Dev1 SC1 MD5	1	☒	☒	☒
TF-162	2	5	9	10	☒	Dev1 SC1 MD1	12	☒	☒	☒
TF-163	1	5	15	16	☒	Dev1 SC1 MD1	13	☒	☒	☒
TF-164	2	2	39	40	☒	Dev1 SC1 MD5	2	☒	☒	☒
TF-165	2	2	37	38	☒	Dev1 SC1 MD5	3	☒	☒	☒
TF-166	2	2	35	36	☒	Dev1 SC1 MD5	4	☒	☒	☒
TF-167	2	3	43	44	☒	Dev1 SC1 MD8	19	☒	☒	☒
TF-168	2	2	31	32	☒	Dev1 SC1 MD5	6	☒	☒	☒
TF-169	1	2	13	14	☒	Dev1 SC1 MD5	7	☒	☒	☒
TF-170	2	2	29	30	☒	Dev1 SC2 MD1	20	☒	☒	☐ OOC
TF-171	12	4	19	20	☒	Dev1 SC2 MD1	21	☒	☒	☒
TF-172	2	2	23	24	☒	Dev1 SC2 MD1	22	☒	☒	☒
TF-173	2	2	25	26	☒	Dev1 SC2 MD1	23	☒	☒	☒
TF-201	13	2	1	2	☒	Dev1 SC1 MD1	14	☒	☒	☒
TF-202	14	2	5	6	☒	Dev1 SC1 MD1	15	☒	☒	☒
TF-203	13	2	9	10	☒	Dev1 SC1 MD1	16	☒	☒	☒
TF-204	14	2	7	8	☒	Dev1 SC1 MD1	17	☒	☒	☒
TF-205	13	2	6	5	☒	Dev2 SC3 MD11	4	☒	☒	☒

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APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-206	12	3	52	53	☒	Dev2 SC3 MD11	5	☒	☒	☒
TF-207	3	1	7	8	☒	Dev1 SC1 MD5	8	☒	☒	☒
TF-208	4	1	5	6	☒	Dev1 SC1 MD5	9	☒	☒	☒
TF-209	3	1	9	10	☒	Dev1 SC1 MD5	10	☒	☒	☒
TF-210	4	1	7	8	☒	Dev1 SC1 MD5	11	☒	☒	☒
TF-211	3	1	11	12	☒	Dev1 SC1 MD5	12	☒	☒	☒
TF-212	4	1	9	10	☒	Dev1 SC1 MD5	13	☒	☒	☒
TF-213	3	1	13	14	☒	Dev1 SC1 MD5	14	☒	☒	☒
TF-214	4	1	11	12	☒	Dev1 SC1 MD5	15	☒	☒	☒
TF-215	3	1	15	16	☒	Dev1 SC1 MD5	16	☒	☒	☒
TF-216	4	1	13	14	☒	Dev1 SC1 MD5	17	☒	☒	☒
TF-217	3	1	17	18	☒	Dev1 SC1 MD5	18	☒	☒	☒
TF-218	4	1	15	16	☒	Dev1 SC1 MD5	19	☒	☒	☒
TF-221	1	4	29	30	☒	Dev1 SC1 MD4	2	☒	☒	☐ OOC
TF-222	2	2	11	12	Not Labelled ☐	Dev1 SC1 MD1	0	☒	☒	☒
TF-223	1	4	31	32	Not Labelled ☐	Dev1 SC1 MD4	7	☒	☒	☒
TF-224	2	2	13	14	Not Labelled ☐	Dev1 SC1 MD1	1	☒	☒	☒
TF-225	1	4	27	28	Not Labelled ☐	Dev1 SC1 MD6	12	☒	☒	☒
TF-226	2	2	15	16	Not Labelled ☐	Dev1 SC1 MD8	13	☒	☒	☒

J. S. Schlam 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-227	1	4	25	26	Not Labeled ☐	Dev1 SC1 MD7	4	☒	☒	☒
TF-228	2	2	17	18	Not Labeled ☐	Dev1 SC1 MD8	14	☒	☒	☒
TF-229	1	4	35	36	Not Labeled ☐ Wired red to yellow yellow to red	Dev1 SC1 MD7	9	☒	☒	☒
TF-230	2	2	19	20	Not Labeled ☐	Dev1 SC1 MD8	15	☒	☒	☒
TF-231	1	4	37	38	Wired red to yellow yellow to red ☐	Dev1 SC1 MD7	10	☒	☒	☒
TF-232	2	2	21	22	Not Labeled ☐	Dev1 SC1 MD8	16	☒	☒	☒
TF-251-1	30	3	5	6	☒	Dev1 SC2 MD7	2	☒	☒	☒
TF-251-2	30	3	7	8	☒	Dev1 SC2 MD7	3	☒	☒	☒
TF-251-3	30	3	9	10	☒	Dev1 SC2 MD7	4	☒	☒	☒
TF-252-1	30	3	11	12	☒	Dev1 SC2 MD7	5	☒	☒	☒
TF-252-2	30	3	13	14	☒	Dev1 SC2 MD7	6	☒	☒	☒
TF-252-3	30	3	15	16	☒	Dev1 SC2 MD7	7	☒	☒	☒
TF-253-1	30	3	17	18	☒	Dev1 SC2 MD7	8	☒	☒	☒
TF-253-2	30	3	19	20	☒	Dev1 SC2 MD7	9	☒	☒	☒
TF-253-3	30	3	21	22	☒	Dev1 SC2 MD7	10	☒	☒	☒
TF-254-1	30	3	23	24	☒	Dev1 SC2 MD7	11	☒	☒	☒
TF-254-2	30	3	25	26	☒	Dev1 SC2 MD7	12	☒	☒	☒
TF-254-3	30	3	27	28	☒	Dev1 SC2 MD7	13	☒	☒	☒
TF-255	30	4	15	16	☒	Dev1 SC2 MD5	7	☒	☒	☒

J. Schlam 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-256	30	4	17	18	☒	Dev1 SC2 MD5	8	☒	☒	☒
TF-257	30	4	19	20	☒	Dev1 SC2 MD5	9	☒	☒	☒
TF-258	30	4	21	22	☒	Dev1 SC2 MD5	10	☒	☒	☒
TF-301	25	4	1	2	☒	Dev2 SC3 MD11	10	☒	☒	☒
TF-305	3	1	21	22	☒	Dev1 SC2 MD1	24	☒	☒	☒
TF-306	4	2	1	2	☒	Dev1 SC2 MD1	25	☒	☒	☒
TF-307	3	2	1	2	☒	Dev1 SC2 MD1	26	☒	☒	☒
TF-308	4	2	3	4	☒	Dev1 SC2 MD1	27	☒	☒	☒
TF-310	26	1	3	4	☒	Dev2 SC3 MD11	11	☒	☒	☒
TF-311	WM				☒	Dev1 SC1 MD1	18	☒	☒	☒
TF-312	WM				☒	Dev1 SC1 MD1	19	☒	☒	☒
TF-401	~~WM~~ 16	1	3	4	☒	Dev1 SC1 MD1	20	☒	☒	☒
TF-402	16	1	1	2	☒	Dev1 SC1 MD1	21	☒	☒	☒
TF-403	15	1	1	2	☒	Dev1 SC1 MD1	22	☒	☒	☒
TF-404	16	1	3	4	☒	Dev1 SC1 MD1	23	☒	☒	☒
TF-405	22	1	1	2	☒	Dev1 SC1 MD1	24	☒	☒	☒
TF-406	20	1	1	2	☒	Dev1 SC1 MD1	25	☒	☒	☒
TF-501	21	2	3	4	☒	Dev1 SC1 MD1	26	☒	☒	☒
TF-502	20	2	5	6	☒	Dev1 SC1 MD1	27	☒	☒	☒

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APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-503	5	1	1	2	☒	Dev1 SC1 MD5	20	☒	☒	☒
TF-504	20	1	4	3	☒	Dev1 SC1 MD5	21	☒	☒	☒
TF-505	5	1	3	4	☒	Dev1 SC1 MD5	22	☒	☒	☒
TF-506	6	1	1	2	☒	Dev1 SC1 MD5	23	☒	☒	☒
TF-507	21	2	1	2	☒	Dev1 SC1 MD5	24	☒	☒	☒
TF-508	6	1	3	4	☒	Dev1 SC1 MD5	25	☒	☒	☒
TF-509	21	1	15	16	☒	Dev1 SC1 MD5	26	☐	☐	☐ OOC
TF-510	20	1	5	6	☒	Dev1 SC1 MD1	28	☒	☒	☒
TF-511	5	1	5	6	☒	Dev1 SC1 MD5	27	☒	☒	☒
TF-512	20	1	7	8	Cannot read label ☐	Dev1 SC1 MD5	28	☒	☒	☐ OOC
TF-513	21	1	13	14	☒	Dev1 SC1 MD5	29	☒	☒	☒
TF-514	6	1	5	6	☒	Dev1 SC1 MD5	30	☒	☒	☒
TF-515	21	1	11	12	☒	Dev1 SC1 MD5	31	☒	☒	☒
TF-516	20	1	9	10	☒	Dev1 SC1 MD6	0	☒	☒	☒
TF-517	5	1	7	8	☒	Dev1 SC1 MD9	19	☒	☒	☒
TF-518	20	1	11	12	☒	Dev1 SC1 MD6	1	☒	☒	☒
TF-519	21	1	9	10	☒	Dev1 SC1 MD6	2	☒	☒	☒
TF-520	6	1	7	8	☒	Dev1 SC1 MD6	3	☒	☒	☒
TF-521	5	1	9	10	☒	Dev1 SC2 MD1	28	☒	☒	☒

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-522	20	1	13	14	☒	Dev1 SC1 MD6	4	☒	☒	☒
TF-523	21	1	7	8	☒	Dev1 SC1 MD6	5	☒	☒	☒
TF-524	6	1	9	10	☒	Dev1 SC1 MD9	26	☒	☒	☒
TF-525	5	1	11	12	☒	Dev1 SC2 MD1	30	☒	☒	☒
TF-526	20	2	11	12	☒	Dev1 SC1 MD6	6	☒	☒	☐ OOC
TF-527	21	1	5	6	☒	Dev1 SC1 MD6	7	☒	☒	☒
TF-528	6	1	10	11	☒	Dev1 SC1 MD9	22	☒	☒	☒
TF-529	21	1	1	2	☒	Dev1 SC1 MD6	8	☒	☒	☒
TF-530	20	2	13	14	☒	Dev1 SC1 MD6	9	☒	☒	☐ OOC
TF-531	24	2	9	10	☒	Dev1 SC1 MD1	29	☒	☒	☒
TF-532	20	1	15	16	☒	Dev1 SC1 MD6	10	☒	☒	☒
TF-533	13	2	13	14	☒	Dev1 SC1 MD6	11	☒	☒	☒
TF-535	22	1	3	4	☒	Dev1 SC1 MD1	30	☒	☒	☒
TF-536	13	2	3	4	☒	Dev1 SC1 MD1	31	☒	☒	☒
TF-537	24	2	7	8	☒	Dev1 SC2 MD2	0	☒	☒	☒
TF-538	23	2	1	2	☒	Dev1 SC2 MD2	1	☒	☒	☒
TF-539	24	2	5	6	☒	Dev1 SC2 MD2	2	☒	☒	☒
TF-540	23	2	3	4	☒	Dev1 SC2 MD2	3	☒	☒	☒
TF-541	24	2	1	2	☒	Dev1 SC2 MD2	4	☒	☒	☒

J. L. Schlenker 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-542	23	2	5	6	☒	Dev1 SC2 MD2	5	☒	☒	☒
TF-543	24	2	3	4	☒	Dev1 SC2 MD2	6	☒	☒	☒
TF-544	23	2	7	8	☒	Dev1 SC2 MD2	7	☒	☒	☒
TF-546	23	2	9	10	☒	Dev1 SC2 MD2	9	☒	☒	☒
TF-547	21	1	3	4	☒	Dev1 SC2 MD2	10	☒	☒	☒
TF-548	20	2	15	16	☒	Dev1 SC2 MD2	11	☒	☒	☒
TF-549	21	2	5	6	☒	Dev1 SC2 MD2	12	☒	☒	☒
TF-550	20	2	1	2	☒	Dev1 SC2 MD2	13	☒	☒	☒
TF-551	24	3	5	6	☒	Dev1 SC2 MD3	20	☒	☒	☒
TF-552	23	1	1	2	☒	Dev1 SC2 MD3	21	☒	☒	☒
TF-553	24	3	3	4	☒	Dev1 SC2 MD3	22	☒	☒	☒
TF-554	23	1	3	4	☒	Dev1 SC2 MD3	23	☒	☒	☒
TF-555	24	3	1	2	☒	Dev1 SC2 MD3	24	☒	☒	☒
TF-556	23	1	5	6	☒	Dev1 SC2 MD3	25	☒	☒	☒
TF-557	24	3	13	14	☒	Dev1 SC2 MD3	26	☒	☒	☒
TF-558	23	1	7	8	☒	Dev1 SC2 MD3	27	☒	☒	☒
TF-559	24	3	11	12	☒	Dev1 SC2 MD3	28	☒	☒	☒
TF-560	23	1	9	10	☒	Dev1 SC2 MD3	29	☒	☒	☒
TF-561	24	3	9	10	☒	Dev1 SC2 MD3	30	☒	☒	☒

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APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-562	23	1	11	12	☒	Dev1 SC2 MD3	31	☒	☒	☒
TF-563	24	3	7	8	☒	Dev1 SC2 MD4	0	☒	☒	☒
TF-564	23	1	13	14	☒	Dev1 SC2 MD4	1	☒	☒	☒
TF-601	18	2	17	18	☒	Dev1 SC1 MD2	0	☒	☒	☒
TF-602	19	3	1	2	☒	Dev1 SC1 MD2	1	☒	☒	☒
TF-603	14	2	11	12	☒	Dev1 SC1 MD2	2	☒	☒	☒
TF-605	18	2	7	8	☒	Dev1 SC1 MD2	3	☒	☒	☒
TF-608	18	2	12	13	☒	Dev2 SC3 MD11	6	☒	☒	☒
TF-609	13	2	15	16	☒	Dev1 SC1 MD2	5	☒	☒	☒
TF-610	14	2	13	14	☒	Dev1 SC1 MD2	6	☒	☒	☒
TF-614	19	3	3	4	☒	Dev1 SC1 MD2	7	☒	☒	☒
TF-615	19	3	5	6	☒	Dev1 SC1 MD2	8	☒	☒	☒
TF-616	26	1	1	2	☒	Dev1 SC1 MD2	9	☒	☒	☒
TF-617	26	1	5	6	Not Installed ☐	Dev1 SC1 MD2	10	☒	☒	☒
TF-618	WM				☒	Dev1 SC1 MD2	11	☒	☒	☒
TF-619	WM				☒	Dev1 SC1 MD2	12	☒	☒	☒
TF-620	12	4	25	26	☒	Dev1 SC1 MD2	13	☒	☒	☒
TF-621	12	4	28	29	☒	Dev1 SC1 MD2	14	☒	☒	☒
TF-622	WM				☒	Dev1 SC1 MD2	15	☒	☒	☒

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APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-623	WM				☒	Dev1 SC1 MD2	16	☒	☒	☒
TF-701	10	1	1	2	☒	Dev1 SC1 MD2	17	☒	☒	☒
TF-702	10	1	3	4	☒	Dev1 SC2 MD2	14	☒	☒	☒
TF-703	10	1	5	6	☒	Dev1 SC2 MD2	15	☒	☒	☒
TF-704	10	1	7	8	☒	Dev1 SC1 MD6	13	☒	☒	☒
TF-705	10	1	9	10	☒	Dev1 SC1 MD6	14	☒	☒	☒
TF-706	10	1	11	12	☒	Dev1 SC1 MD6	15	☒	☒	☒
TF-707	10	2	7	8	☒	Dev1 SC1 MD6	16	☒	☒	☒
TF-708	10	2	11	12	☒	Dev1 SC1 MD6	17	☒	☒	☒
TF-709	10	2	1	2	☒	Dev1 SC1 MD6	18	☒	☒	☒
TF-710	10	2	3	4	☒	Dev1 SC1 MD6	19	☒	☒	☒
TF-711	10	2	5	6	☒	Dev1 SC1 MD6	20	☒	☒	☒
TF-712	10	2	9	10	☒	Dev1 SC1 MD2	18	☒	☒	☒
TF-713	WM				☒	Dev1 SC1 MD2	19	☒	☒	☒
TF-714	WM				☒	Dev1 SC1 MD2	20	☒	☒	☒
TF-715	11	2	7	8	☒	Dev1 SC1 MD6	21	☒	☒	☒
TF-716	11	2	5	6	☒	Dev2 SC3 MD11	7	☒	☒	☒
TF-717	11	2	1	2	☒	Dev1 SC1 MD6	22	☒	☒	☒
TF-718	11	2	3	4	☒	Dev1 SC1 MD2	21	☒	☒	☒

J. L. Schlam 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-719	17	1	13	14	Not Labelled ☐	Dev1 SC2 MD2	16	☒	☒	☒
TF-720	20	2	7	8	☒	Dev1 SC2 MD2	17	☒	☒	☒
TF-721	22	2	7	8	☒	Dev1 SC2 MD2	18	☒	☒	☒
TF-722	Wm				☒	Dev1 SC2 MD4	2	☒	☒	☒
TF-723	18	1	17	18	☒	Dev1 SC2 MD4	3	☒	☒	☒
TF-801	Wm				☒	Dev1 SC1 MD2	22	☒	☒	☒
TF-802	Wm				☒	Dev1 SC1 MD2	23	☒	☒	☒
TF-803	18	2	5	6	☒	Dev1 SC1 MD2	24	☒	☒	☒
TF-804	18	2	15	16	☒	Dev1 SC1 MD2	25	☒	☒	☒
TF-805	18	1	5	6	☒	Dev1 SC1 MD6	23	☒	☒	☒
TF-806	18	1	7	8	☒	Dev1 SC1 MD6	26	☒	☒	☒
TF-808	18	1	9	10	☒	Dev1 SC1 MD6	28	☒	☒	☒
TF-809	18	1	11	12	☒	Dev1 SC1 MD6	24	☒	☒	☒
TF-810	18	1	13	14	☒	Dev1 SC1 MD6	27	☒	☒	☒
TF-811	18	1	15	16	☒	Dev1 SC1 MD7	0	☒	☒	☒
TF-812	18	1	21	22	☒	Dev1 SC2 MD2	19	☒	☒	☒
TF-813	22	1	7	8	☒	Dev1 SC2 MD2	20	☒	☒	☒
TF-814	20	2	9	10	☒	Dev1 SC2 MD2	21	☒	☒	☒
TF-901	Wm				☒	Dev1 SC1 MD2	26	☒	☒	☒

J. S. Schikam 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TF-902	WM				☒	Dev2 SC3 MD11	8	☒	☒	☒
TF-903	WM				☒	Dev2 SC3 MD11	9	☒	☒	☒
TF-904	20	2	3	4	☒	Dev1 SC1 MD2	27	☒	☒	☒
TF-905	WM				☒	Dev1 SC1 MD3	0	☒	☒	☒
TF-906	WM				☒	Dev1 SC2 MD4	4	☒	☒	☒
TF-907	WM				☒	Dev1 SC1 MD3	1	☒	☒	☒
TF-908	12	4	41	42	☒	Dev1 SC2 MD3	10	☒	☒	☒
TF-909	22	1	5	6	☒	Dev1 SC1 MD3	2	☒	☒	☒
TF-910	WM				☒	Dev1 SC2 MD2	22	☒	☒	☒
TF-911	WM				☒	Dev1 SC2 MD2	23	☒	☒	☒
TF-912	WM				☒	Dev1 SC1 MD2	4	☒	☒	☒
TF-913	12	4	36	37	☒	Dev1 SC1 MD4	3	☒	☒	☒
TF-914	WM				☒	Dev2 SC3 MD11	14	☒	☒	☒
TF-915	WM				☒	Dev1 SC2 MD3	11	☒	☒	☒
TF-916	WM				☒	Dev1 SC2 MD3	12	☒	☒	☒
TF-917	25	1	7	8	☒	Dev2 SC3 MD11	15	☒	☒	☒
TF-918	WM				☒	Dev1 SC2 MD3	13	☒	☒	☒
TH-103	2	4	39	40	labeled TE103 ☐	Dev2 SC3 MD11	16	☒	☒	☒
TH-211	2	5	39	40	labeled TE211 ☐	Dev2 SC3 MD11	18	☒	☒	☒

JL Gilliam 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TH-305	2	5	40	41	Labelled TC305 ☐	Dev2 SC3 MD11	20	☒	☒	☒
TH-309	2	4	31	32	Labelled TC309 ☐	Dev2 SC3 MD11	17	☒	☒	☒
TH-401	2	3	29	30	Labelled TC401 ☐	Dev2 SC3 MD11	19	☒	☒	☒
TH-507	2	5	35	36	Labelled TC507 ☐	Dev2 SC3 MD11	21	☒	☒	☒
TH-601	4	3	19	20	☒	Dev1 SC1 MD7	1	☒	☒	☒
TH-602	4	3	21	22	☒	Dev1 SC1 MD7	2	☒	☒	☒
TH-603	4	2	15	16	☒	Change to 321 MD10 28 Dev1 SC1 MD10	12	☐ no connection	☒	☒
TH-604	4	2	19	20	☒	Dev1 SC1 MD9	25	☒	☒	☒
TR-001-1	2	3	1	2	☒	Dev1 SC1 MD3	3	☒	☒	☒
TR-001-2	2	3	3	4	☒	Dev1 SC1 MD3	4	☒	☒	☒
TR-001-3	2	3	5	6	☒	Dev1 SC1 MD3	5	☒	☒	☒
TR-001-4	2	3	7	8	☒	Dev1 SC1 MD3	6	☒	☒	☒
TR-001-5	2	3	9	10	☒	Dev1 SC1 MD3	7	☒	☒	☒
TR-001-6	2	3	11	12	☒	Dev1 SC1 MD3	8	☒	☒	☒
TR-303-1	2	3	13	14	☒	Dev1 SC1 MD3	11	☒	☒	☒
TR-303-2	2	3	15	16	☒	Dev1 SC1 MD3	12	☒	☒	☒
TR-303-3	2	3	17	18	☒	Dev1 SC1 MD3	13	☒	☒	☒
TR-303-4	2	3	19	20	☒	Dev1 SC1 MD3	14	☒	☒	☒
TR-303-5	2	3	21	22	☒	Dev1 SC1 MD3	15	☒	☒	☒

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APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TR-303-6	2	4	1	2	☒	Dev1 SC1 MD3	16	☒	☒	☒
TR-308-1	2	3	1	2	☒	Dev1 SC1 MD3	19	☒	☒	☒
TR-308-2	2	3	3	4	☒	Dev1 SC1 MD3	20	☒	☒	☒
TR-308-3	2	3	5	6	☒	Dev1 SC1 MD3	21	☒	☒	☒
TR-308-4	2	3	7	8	☒	Dev1 SC1 MD3	9	☒	☒	☒
TR-308-5	2	3	9	10	☒	Dev1 SC1 MD3	10	☒	☒	☒
TR-308-6	2	3	11	12	☒	Dev1 SC1 MD3	17	☒	☒	☒
TR-313-1	2	4	3	4	☒	Dev1 SC1 MD3	22	☒	☒	☒
TR-313-2	2	4	5	6	☒	Dev1 SC1 MD3	23	☒	☒	☒
TR-313-3	2	4	7	8	☒	Dev1 SC1 MD3	24	☒	☒	☒
TR-313-4	2	4	9	10	☒	Dev1 SC1 MD3	25	☒	☒	☒
TR-313-5	2	4	11	12	☒	Dev1 SC1 MD3	26	☒	☒	☒
TR-313-6	2	4	13	14	☒	Dev1 SC1 MD3	27	☒	☒	☒
TR-318-1	2	4	15	16	☒	Dev1 SC1 MD3	30	☒	☒	☒
TR-318-2	2	4	17	18	☒	Dev1 SC1 MD3	31	☒	☒	☒
TR-318-3	2	4	19	20	☒	Dev1 SC1 MD4	0	☒	☒	☒
TR-318-4	2	4	21	22	☒	Dev1 SC1 MD3	18	☒	☒	☒
TR-318-5	2	4	23	24	☒	Dev1 SC1 MD3	28	☒	☒	☒
TR-318-6	2	4	25	26	☒	Dev1 SC1 MD3	29	☒	☒	☒

J L Schlum 5/16/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TW-201	3	2	5	6	☒	Dev1 SC1 MD9	9	☒	☒	☐
TW-202	4	2	5	6	☒	Dev1 SC1 MD9	10	☒	☒	OOC ☐
TW-203	3	2	7	8	☒	Dev1 SC1 MD9	11	☒	☒	☐
TW-204	4	2	7	8	☒	Dev1 SC1 MD9	12	☒	☒	OOC ☐
TW-205	3	2	9	10	☒	Dev1 SC1 MD9	13	☒	☒	OOC ☐
TW-206	4	2	9	10	☒	Dev1 SC1 MD9	14	☐	☐	OOC ☐
TW-208	4	2	11	12	☒	Dev1 SC1 MD9	15	☒	☒	☒
TW-209	3	2	13	14	☒	Dev1 SC1 MD9	16	☒	☒	OOC ☐
TW-210	4	2	13	14	☒	Dev1 SC1 MD9	18	☒	☒	OOC ☐
TW-601	26	13	3	4	☒	Dev1 SC2 MD2	26	☒	☒	☒
TW-602	12	4	38	39	☒	Dev1 SC2 MD2	27	☒	☒	☒
TW-603	12	4	34	35	☒	Dev1 SC2 MD3	0	☒	☒	☒
TW-801	18	1	23	24	☒	Dev1 SC2 MD3	1	☒	☒	☒
TW-802	18	1	25	26	☒	Dev1 SC2 MD3	2	☒	☒	☒
TW-803	18	1	27	28	☒	Dev1 SC2 MD3	3	☒	☒	OOC ☐
TW-804	18	1	29	30	☒	Dev1 SC2 MD3	4	☒	☒	OOC ☐
TW-805	18	2	1	2	☒	Dev1 SC2 MD3	5	☒	☒	☒
TW-806	18	2	3	4	☒	Dev1 SC2 MD3	6	☒	☒	☒
TW-807	18	2	9	10	☒	Dev1 SC2 MD3	7	☒	☒	☒

J. L. Schlemmer 5/14/03

APPENDIX A for OSU-D-04

Tagname	Junction Box	Terminal Board	Wire Yellow(+)	Wire Red (-)	Wire Labelled Correctly	DAS Configuration		DAS Validation		Steady State
						Device	Channel	Sig Response	Sig Stored	Response
TW-808	18	2	11	12	☒	Dev1 SC2 MD3	8	☒	☒	☒
TW-905	12	4	31	32	☒	Dev1 SC2 MD3	9	☒	☒	☒

J. L. Schlam 5/16/03

OREGON STATE UNIVERSITY

DEPARTMENT OF NUCLEAR ENGINEERING

ADVANCED THERMAL HYDRAULIC RESEARCH LABORATORY

OSU-D-05

AP1000 TRANSMITTER CHANNEL VALIDATION

Revision 0

Jerry Schlman, Originator — Date 7/15/03
Research Assistant

John Groome — Date 7/15/03
Facility Operations Manager
Research Assistant

Jose Reyes — Date 7/15/03
Program Manager
Professor

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APPENDIX A

1.0 OBJECTIVES

The objective of this procedure is to perform a transmitter channel validation of the Data Acquisition System (DAS) upgrade. To perform the channel validation, a known signal will be simulated at the at the instrument.

2.0 REFERENCES

2.1 The following OSU P&IDs are referenced:

OSU 600LEG	Sheet 1 of 2	Rev 6
OSU 600LEG	Sheet 2 of 2	Rev 7
OSU 600002	Sheet 1 of 2	Rev 11
OSU 600002	Sheet 2 of 2	Rev 43
OSU 600007	Sheet 1 of 1	Rev 4
OSU 600008	Sheet 1 of 2	Rev 4
OSU 600101	Sheet 1 of 2	Rev 6
OSU 600101	Sheet 2 of 2	Rev 4
OSU 600203	Sheet 1 of 1	Rev 11
OSU 600206	Sheet 1 of 1	Rev 10
OSU 600301	Sheet 1 of 1	Rev 10
OSU 600501	Sheet 1 of 1	Rev 6
OSU 600502	Sheet 1 of 1	Rev 6
OSU 600701	Sheet 1 of 1	Rev 8
OSU 600901	Sheet 1 of 1	Rev 6
OSU 600902	Sheet 1 of 1	Rev 3
OSU 600903	Sheet 1 of 1	Rev 3
OSU 600904	Sheet 1 of 1	Rev 1

2.2 Administrative Procedure A-05, Testing Administration, Revision 2.

2.3 ATHRL Quality Plan, Revision 2.

2.4 ATHRL Maintenance and Operations Procedures Manual

3.0 PREREQUISITES

STEP 3.1 ☒ Verify all transmitters are installed and wiring to DAS is complete.

STEP 3.2 ☒ Verify DAS is operational and available to log data channels.

STEP 3.3 ☒ Perform pre-test brief.

Test Engineer Signature J. L. Schlamp Date 7/15/02

4.0 TRANSMITTER CHANNEL VALIDATION CHECK

NOTE: To verify that the critical transmitters (pressure, flow, and signal conditioners) have been properly wired and configured to the DAS, a 0% (4 mA/1 volt), 50% (12 mA/3 volt), and 100% (20 mA/5 volt) signal will be simulated by using either:

1) Hand held communicator,
2) Instrument front panel interface, or
3) Process meter capable of simulating a 4-20 mA signal.

The DAS operator will verify and record the DAS computer reading.

STEP 4.1 ☒ Configure the DAS to log all transmitter channels listed in Appendix A at a minimum scan rate of 1 second.

STEP 4.2 ☒ Start the DAS Historian. Launch Real Time Server and historical trend application.

STEP 4.3 ☒ For each transmitter listed on Appendix A, refer to the "OSU Maintenance and Operations Procedures" manual and simulate a 0%, 50%, and 100% signal.

NOTE: Allow each signal adequate time to stabilize before simulating the next step. Record DAS computer reading on Appendix A.

STEP 4.4 ☒ Confirm historical trend shows correct response and that the data point was saved to disk.

STEP 4.5 ☒ Record results/discrepancies on Appendix A.

Test Engineer Signature _____ Date 1/25/03

5.0 POST-TEST ACTIVITIES

STEP 5.1 ☒ Plot all critical instrument channels and review channel plots for expected readings/response. Note any discrepancies in the test log.

Test Engineer Signature J. Schlamp Date 7/25/03

6.0 ACCEPTANCE CRITERIA

STEP 6.1 ☒ Critical instruments functioned throughout the test.

STEP 6.2 ☑ All test steps were performed as written. Any deviation from the test procedures have been dispositioned and approved as required per Reference 2.4.

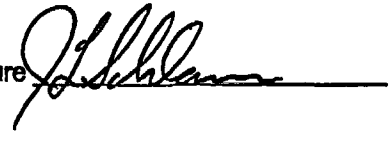
ACCEPTANCE CRITERIA MET

J. L. Schlaman		7/25/03
Test Engineer Name	Test Engineer Signature	Date

Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
DP-111	-30	30	in H2O	-30	-29.95	0	0.0094	30	30.14	± 0.3	Yes	Yes
DP-114	-375	375	in H2O	-375	-372.89	0	2.185	375	377.209	± 3.75	Yes	Yes
DP-121	-25	25	in H2O	-25	-24.977	0	0.0028	25	25.037	± 0.25	Yes	Yes
DP-122	-25	25	in H2O	-25	-24.95	0	0.055	25	25.04	± 0.25	Yes	Yes
DP-123	-25	25	in H2O	-25	-24.96	0	0.051	25	25.06	± 0.25	Yes	Yes
DP-124	-25	25	in H2O	-25	-24.95	0	0.038	25	25.04	± 0.25	Yes	Yes
DP-125	0	30	in H2O	0	0.0288	15	15.03	30	30.04	± 0.15	Yes	Yes
DP-126	0	30	in H2O	0	0.026	15	15.03	30	30.03	± 0.15	Yes	Yes
DP-128	-25	25	in H2O	-25	-24.96	0	0.037	25	25.04	± 0.25	Yes	Yes
DP-129	-25	25	in H2O	-25	-24.965	0	0.041	25	25.05	± 0.25	Yes	Yes
DP-130	-50	50	in H2O	-50	-49.91	0	0.001	50	50.11	± 0.5	Yes	Yes
DP-201	-25	25	in H2O	-25	-24.96	0	0.05	25	25.06	± 0.25	Yes	Yes
DP-202	0	200	in H2O	0	0.174	100	100.2	200	200.2	± 1	Yes	Yes
DP-203	0	200	in H2O	0	0.009	100	99.97	200	199.97	± 1	Yes	Yes
DP-204	-25	25	in H2O	-25	-24.96	0	0.044	25	25.07	± 0.25	Yes	Yes
DP-205	0	200	in H2O	0	0.552	100	100.63	200	200.65	± 1	Yes	Yes
DP-206	0	200	in H2O	0	0.147	100	100.16	200	200.14	± 1	Yes	Yes
DP-207	-25	25	in H2O	-25	-24.956	0	0.055	25	25.067	± 0.25	Yes	Yes
DP-208	-25	25	in H2O	-25	-24.96	0	0.036	25	25.05	± 0.25	Yes	Yes
DP-209	-25	25	in H2O	-25	-24.965	0	0.04	25	25.046	± 0.25	Yes	Yes
DP-210	-25	25	in H2O	-25	-24.998	0	-0.0019	25	24.995	± 0.25	Yes	Yes
DP-211	0	25	in H2O	0	0.023	12.5	12.526	25	25.029	± 0.125	Yes	Yes
DP-212	0	25	in H2O	0	0.025	12.5	12.53	25	25.03	± 0.125	Yes	Yes
DP-213	-15	15	in H2O	-15	-14.91	0	0.089	15	15.099	± 0.15	Yes	Yes
DP-214	0	15	in H2O	0	0.013	7.5	7.516	15	15.016	± 0.075	Yes	Yes
DP-215	0	500	psid	0	1.4519	250	251.561	500	501.67	± 2.5	Yes	Yes
DP-216	0	500	psid	0	0.3574	250	250.364	500	500.562	± 2.5	Yes	Yes
DP-217	0	150	in H2O	0	0.4768	75	75.492	150	150.508	± 0.75	Yes	Yes
DP-218	0	150	in H2O	0	0.141	75	75.16	150	150.21	± 0.75	Yes	Yes
DP-219	0	150	in H2O	0	0.149	75	75.14	150	150.17	± 0.75	Yes	Yes
DP-220	0	150	in H2O	0	0.115	75	75.117	150	150.154	± 0.75	Yes	Yes
DP-221	0	150	in H2O	0	0.101	75	75.15	150	150.16	± 0.75	Yes	Yes
DP-222	0	150	in H2O	0	0.128	75	75.11	150	150.16	± 0.75	Yes	Yes
DP-223	0	150	in H2O	0	0.131	75	75.15	150	150.171	± 0.75	Yes	Yes

Test Engineer Signature _____ Date 7/25/03 7/24/03

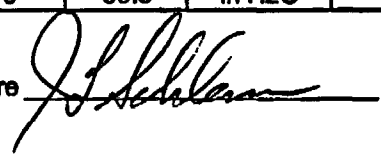
Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
DP-224	0	150	in H2O	0	0.027	75	75.01	150	150.02	± 0.75	Yes	Yes
DP-401	0	400	in H2O	0	1.143	200	201.24	400	401.27	± 2	Yes	Yes
DP-402	0	400	in H2O	0	0.316	200	200.39	400	400.45	± 2	Yes	Yes
DP-501	-150	150	in H2O	-150	-149.28	0	0.828	150	150.882	± 1.5	Yes	Yes
DP-502	-150	150	in H2O	-150	-149.72	0	0.301	150	150.367	± 1.5	Yes	Yes
DP-503	-150	150	in H2O	-150	-149.74	0	0.2816	150	150.378	± 1.5	Yes	Yes
DP-504	-100	100	in H2O	-100	-99.375	0	0.663	100	100.701	± 1	Yes	Yes
DP-611	-25	25	in H2O	-25	-24.955	0	0.039	25	25.056	± 0.25	Yes	Yes
DP-701	0	30	psid	0	0.024	15	15.03	30	30.03	± 0.15	Yes	Yes
DP-702	0	30	psid	0	0.028	15	15.03	30	30.04	± 0.15	Yes	Yes
DP-905	0	100	psid	0	-0.005	50	49.99	100	99.99	± 0.5	Yes	Yes
FDP-604	0	100	psid	0	0.3015	50	50.317	100	100.333	± 0.5	Yes	Yes
FDP-605	0	250	psid	0	0.769	125	125.775	250	250.819	± 1.25	Yes	Yes
FDP-606	0	100	psid	0	0.3286	50	50.3256	100	100.353	± 0.5	Yes	Yes
FMM-001	0	6	gpm	0	-0.001	3	2.9966	6	5.9989	± 0.03	Yes	Yes
FMM-002	0	6	gpm	0	-0.0019	3	2.9958	6	5.997	± 0.03	Yes	Yes
FMM-201	-100	100	gpm	-100	-99.665	0	0.265	100	100.248	± 1	Yes	Yes
FMM-202	-100	100	gpm	-100	-99.66	0	0.2895	100	100.275	± 1	Yes	Yes
FMM-203	-100	100	gpm	-100	-99.6	0	-0.239	100	99.137	± 1	Yes	Yes
FMM-204	-100	100	gpm	-100	-99.67	0	0.266	100	100.256	± 1	Yes	Yes
FMM-205	0	75	gpm	0	0.06967	37.5	37.53	75	75.135	± 0.375	Yes	Yes
FMM-206	0	75	gpm	0	0.051	37.5	37.537	75	75.129	± 0.375	Yes	Yes
FMM-401	0	40	gpm	0	0.03561	20	20.07	40	40.062	± 0.2	Yes	Yes
FMM-402	0	40	gpm	0	0.038	20	20.025	40	40.065	± 0.2	Yes	Yes
FMM-501	0	75	gpm	0	0.07234	37.5	37.46	75	75.134	± 0.375	Yes	Yes
FMM-502	0	70	gpm	0	0.0655	35	35.106	70	70.098	± 0.35	Yes	Yes
FMM-503	0	75	gpm	0	0.06036	37.5	37.593	75	75.132	± 0.375	Yes	Yes
FMM-504	0	20	gpm	0	0.019	10	10.02	20	20.03	± 0.1	Yes	Yes
FMM-601	0	200	gpm	0	0.1557	100	100.45	200	200.857	± 1	Yes	Yes
FMM-602	0	60	gpm	0	-0.001	30	29.98	60	59.96	± 0.3	Yes	Yes
FMM-603	0	60	gpm	0	-0.001	30	29.977	60	59.997	± 0.3	Yes	Yes
FMM-701	0	40	gpm	0	0.03333	20	20.022	40	40.047	± 0.2	Yes	Yes
FMM-702	0	40	gpm	0	0.0306	20	20.023	40	40.043	± 0.2	Yes	Yes
FMM-703	0	10	gpm	0	0.007	5	5.005	10	10.009	± 0.05	Yes	Yes

Test Engineer Signature  Date 7/25/03

Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
FMM-801	0	8	gpm	0	-0.0006	4	3.9956	8	7.9937	± 0.04	Yes	Yes
FMM-802	0	40	gpm	0	0.031	20	20.06	40	40.048	± 0.2	Yes	Yes
FMM-803	0	30	gpm	0	0.0286	15	15.024	30	30.04	± 0.15	Yes	Yes
FMM-804	0	40	gpm	0	0.035	20	20.07	40	40.056	± 0.2	Yes	Yes
FMM-805	0	40	gpm	0	-0.0002	20	19.975	40	39.994	± 0.2	Yes	Yes
FMM-901	0	100	gpm	0	0.08989	50	50.0849	100	100.141	± 0.5	Yes	Yes
FMM-902	0	40	gpm	0	0.035	20	20.06	40	40.07	± 0.2	Yes	Yes
FMM-905	-90	90	gpm	-90	-90.07	0	-0.049	90	89.973	± 0.9	Yes	Yes
FVM-001	0	70	cfm	0	0.119	35	35.131	70	70.127	± 0.35	Yes	Yes
FVM-002	0	70	cfm	0	0.148	35	35.159	70	70.169	± 0.35	Yes	Yes
FVM-003	0	140	cfm	0	0.188	70	70.646	140	140.685	± 0.7	Yes	Yes
FVM-009	0	381	cfm	0	0.119	190.5	190.51	381	381.11	± 1.905	Yes	Yes
FVM-010	0	381	cfm	0	0.129	190.5	190.625	381	381.21	± 1.905	Yes	Yes
FVM-601	0	2000	cfm	0	9.46	1000	1009.8	2000	2009.97	± 10	Yes	Yes
FVM-602	0	2000	cfm	0	1.35	1000	1001.93	2000	2002.97	± 10	Yes	Yes
FVM-603	0	1600	cfm	0	0.632	800	800.873	1600	1600.97	± 8	Yes	Yes
FVM-604	0	265	cfm	0	-0.164	132.5	132.3	265	264.765	± 1.325	Yes	Yes
FVM-605	0	265	cfm	0	-0.113	132.5	132.4	265	264.9	± 1.325	Yes	Yes
FVM-901	0	5000	cfm	0	-0.657	2500	2498.89	5000	4998.06	± 25	Yes	Yes
FVM-902	0	12500	cfm	0	-1.04	6250	6280.82	12500	12526.4	± 62.5	Yes	Yes
FVM-903	0	22	cfm	0	0.0856	11	11.08	22	22.07	± 0.11	Yes	Yes
FVM-904	0	400	cfm	0	-0.0166	200	199.914	400	399.876	± 2	Yes	Yes
FVM-905	0	6000	cfm	0	17.3928	3000	3019.08	6000	6020.76	± 30	Yes	Yes
FVM-906	0	4000	cfm	0	14.758	2000	2010.09	4000	4006.35	± 20	Yes	Yes
HPS-203-3	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-206-1	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-206-2	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-206-3	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-509-1	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-509-2	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-509-3	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-512-1	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-512-2	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-512-3	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	

Test Engineer Signature J. Schulman Date 7/25/03

Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
HPS-606-1	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-606-2	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-606-3	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-607-3	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-801-1	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
HPS-801-2	0	10	Voltage (V)	0		5		10		± 0.05	Not performed	
KW-101	0	472	kW	0	0.0004	236	235.38	472	470.9	± 2.36	Yes	Yes
KW-102	0	486	kW	0	-0.18	243	242.163	486	484.91	± 2.43	Yes	Yes
KW-103	0	496	kW	0	0.2176	248	248.104	496	495.876	± 2.48	Yes	Yes
KW-104	0	492	kW	0	0.24	246	246.211	492	491.99	± 2.46	Yes	Yes
KW-601	0	24.3	kW	0	0.0809	12.15	12.117	24.3	24.235	± 0.122	Yes	Yes
LCT-701	0	40000	lbm	0	-11.13	20000	20060.3	40000	40068.8	± 200	Yes	Yes
LCT-901	0	28800	lbm	0	10.35	14400	14409.7	28800	28813.5	± 144	Yes	Yes
LCT-902	0	16700	lbm	0	4.406	8350	8355.8	16700	16707.4	± 83.5	Yes	Yes
LDP-001	0	91.88	in H2O	0	-0.0003	45.94	45.921	91.88	91.86	± 0.459	Yes	Yes
LDP-101	0	5.561	in H2O	0	0.011	2.7805	2.78	5.561	5.56	± 0.028	Yes	Yes
LDP-102	0	5.938	in H2O	0	0.018	2.969	2.97	5.938	5.939	± 0.03	Yes	Yes
LDP-103	0	11.692	in H2O	0	0.011	5.846	5.859	11.692	11.707	± 0.058	Yes	Yes
LDP-104	0	12.376	in H2O	0	0.015	6.188	6.21	12.376	12.39	± 0.062	Yes	Yes
LDP-105	0	11.929	in H2O	0	0.011	5.9645	5.976	11.929	11.938	± 0.06	Yes	Yes
LDP-106	0	8.198	in H2O	0	0.009	4.099	4.109	8.198	8.209	± 0.041	Yes	Yes
LDP-107	0	8.223	in H2O	0	0.00806	4.1115	4.12	8.223	8.232	± 0.041	Yes	Yes
LDP-108	0	8.562	in H2O	0	0.0007	4.281	4.288	8.562	8.57	± 0.043	Yes	Yes
LDP-109	0	19.763	in H2O	0	0.00176	9.8815	9.904	19.763	19.786	± 0.099	Yes	Yes
LDP-110	0	20.02	in H2O	0	0.00169	10.01	10.032	20.02	20.044	± 0.1	Yes	Yes
LDP-112	0	4.696	in H2O	0	0.0001	2.348	2.348	4.696	4.693	± 0.023	Yes	Yes
LDP-113	0	15.614	in H2O	0	0.0012	7.807	7.822	15.614	15.631	± 0.078	Yes	Yes
LDP-115	0	24.28	in H2O	0	0.00154	12.14	12.161	24.28	24.304	± 0.121	Yes	Yes
LDP-116	0	77.59	in H2O	0	0.076	38.795	38.86	77.59	77.68	± 0.388	Yes	Yes
LDP-117	0	11.383	in H2O	0	0.011	5.6915	5.704	11.383	11.397	± 0.057	Yes	Yes
LDP-118	0	39.98	in H2O	0	0.036	19.99	20.026	39.98	40.029	± 0.2	Yes	Yes
LDP-119	0	40.26	in H2O	0	0.036	20.13	20.17	40.26	40.307	± 0.201	Yes	Yes
LDP-127	0	98.97	in H2O	0	-0.0018	49.485	49.467	98.97	98.969	± 0.495	Yes	Yes
LDP-138	0	39.3	in H2O	0	0.0386	19.65	19.692	39.3	39.36	± 0.197	Yes	Yes

Test Engineer Signature  Date 7/25/03

Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
LDP-139	0	24.166	in H2O	0	0.00181	12.083	12.037	24.166	24.187	± 0.121	Yes	Yes
LDP-140	0	78.02	in H2O	0	0.07	39.01	39.09	78.02	78.11	± 0.39	Yes	Yes
LDP-141	0	20.135	in H2O	0	-0.0002	10.0675	10.0624	20.135	20.133	± 0.101	Yes	Yes
LDP-201	0	2.496	in H2O	0	0.0007	1.248	1.2487	2.496	2.4965	± 0.012	Yes	Yes
LDP-202	0	2.223	in H2O	0	0.0002	1.1115	1.1111	2.223	2.223	± 0.011	Yes	Yes
LDP-203	0	2.532	in H2O	0	0.00008	1.266	1.266	2.532	2.532	± 0.013	Yes	Yes
LDP-204	0	2.47	in H2O	0	-0.0001	1.235	1.235	2.47	2.4703	± 0.012	Yes	Yes
LDP-205	0	4.085	in H2O	0	0.004	2.0425	2.046	4.085	4.089	± 0.02	Yes	Yes
LDP-206	0	4.013	in H2O	0	0.0025	2.0065	2.009	4.013	4.017	± 0.02	Yes	Yes
LDP-207	0	21.321	in H2O	0	0.02	10.6605	10.678	21.321	21.34	± 0.107	Yes	Yes
LDP-208	0	19.247	in H2O	0	0.014	9.6235	9.641	19.247	19.267	± 0.096	Yes	Yes
LDP-209	0	10.939	in H2O	0	0.033	5.4695	5.503	10.939	10.975	± 0.055	Yes	Yes
LDP-210	0	16.988	in H2O	0	0.011	8.494	8.51	16.988	17.000	± 0.085	Yes	Yes
LDP-211	0	16.793	in H2O	0	0.046	8.3965	8.457	16.793	16.846	± 0.084	Yes	Yes
LDP-212	0	16.772	in H2O	0	0.016	8.386	8.405	16.772	16.795	± 0.084	Yes	Yes
LDP-213	0	16.747	in H2O	0	0.013	8.3735	8.388	16.747	16.766	± 0.084	Yes	Yes
LDP-214	0	11.571	in H2O	0	0.034	5.7855	5.82	11.571	11.61	± 0.058	Yes	Yes
LDP-215	0	102.06	in H2O	0	0.097	51.03	51.13	102.06	102.18	± 0.51	Yes	Yes
LDP-216	0	95.55	in H2O	0	0.088	47.775	47.887	95.55	95.67	± 0.478	Yes	Yes
LDP-217	0	96.25	in H2O	0	0.019	48.125	48.133	96.25	96.248	± 0.481	Yes	Yes
LDP-218	0	103.14	in H2O	0	0.097	51.57	51.67	103.14	103.25	± 0.516	Yes	Yes
LDP-219	0	102.45	in H2O	0	0.091	51.225	51.31	102.45	102.56	± 0.512	Yes	Yes
LDP-220	0	96	in H2O	0	0.098	48	48.09	96	96.11	± 0.48	Yes	Yes
LDP-221	0	95.98	in H2O	0	0.091	47.99	48.08	95.98	96.09	± 0.48	Yes	Yes
LDP-222	0	102.71	in H2O	0	0.099	51.355	51.44	102.71	102.81	± 0.514	Yes	Yes
LDP-301	0	119.25	in H2O	0	0.252	59.625	59.86	119.25	119.456	± 0.596	Yes	Yes
LDP-302	0	119.02	in H2O	0	0.254	59.51	59.76	119.02	119.22	± 0.595	Yes	Yes
LDP-303	0	31.81	in H2O	0	0.066	15.905	15.966	31.81	31.862	± 0.159	Yes	Yes
LDP-304	0	31.52	in H2O	0	0.064	15.76	15.82	31.52	31.58	± 0.158	Yes	Yes
LDP-401	0	37.49	in H2O	0	0.007	18.745	18.81	37.49	37.56	± 0.187	Yes	Yes
LDP-402	0	38.34	in H2O	0	0.007	19.17	19.24	38.34	38.41	± 0.192	Yes	Yes
LDP-501	0	5.31	in H2O	0	0.003	2.655	2.659	5.31	5.315	± 0.027	Yes	Yes
LDP-502	0	57.5	in H2O	0	0.108	28.75	28.85	57.5	57.6	± 0.288	Yes	Yes
LDP-503	0	46.77	in H2O	0	0.024	23.385	23.41	46.77	46.81	± 0.234	Yes	Yes

Test Engineer Signature  Date 7/26/03

Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
LDP-504	0	5.226	in H2O	0	0.0146	2.613	2.628	5.226	5.242	± 0.026	Yes	Yes
LDP-505	0	5.486	in H2O	0	0.001	2.743	2.744	5.486	5.487	± 0.027	Yes	Yes
LDP-506	0	46.96	in H2O	0	0.042	23.48	23.52	46.96	47.01	± 0.235	Yes	Yes
LDP-507	0	57.5	in H2O	0	0.124	28.75	28.88	57.5	57.655	± 0.288	Yes	Yes
LDP-508	0	5.309	in H2O	0	0.004	2.6545	2.659	5.309	5.315	± 0.027	Yes	Yes
LDP-509	0	78.84	in H2O	0	0.236	39.42	39.66	78.84	79.1	± 0.394	Yes	Yes
LDP-510	0	78.28	in H2O	0	0.24	39.14	39.309	78.28	78.54	± 0.391	Yes	Yes
LDP-601	0	140.47	in H2O	0	-0.04	70.235	70.2	140.47	140.4	± 0.702	Yes	Yes
LDP-602	0	47.5	in H2O	0	0.0485	23.75	23.8	47.5	47.56	± 0.238	Yes	Yes
LDP-603	0	7.737	in H2O	0	0.005	3.8685	3.875	7.737	7.746	± 0.039	Yes	Yes
LDP-604	0	7.632	in H2O	0	0.0024	3.816	3.818	7.632	7.634	± 0.038	Yes	Yes
LDP-605	0	3.533	in H2O	0	0.0026	1.7665	1.7696	3.533	3.5371	± 0.018	Yes	Yes
LDP-606	0	18.696	in H2O	0	0.016	9.348	9.367	18.696	18.721	± 0.093	Yes	Yes
LDP-607	0	4.127	in H2O	0	0.003	2.0635	2.067	4.127	4.131	± 0.021	Yes	Yes
LDP-608	0	3.82	in H2O	0	0.0031	1.91	1.913	3.82	3.824	± 0.019	Yes	Yes
LDP-609	0	14.717	in H2O	0	0.041	7.3585	7.402	14.717	14.764	± 0.074	Yes	Yes
LDP-610	0	45.24	in H2O	0	0.01	22.62	22.64	45.24	45.26	± 0.226	Yes	Yes
LDP-611	0	55.97	in H2O	0	0.151	27.985	28.145	55.97	56.131	± 0.28	Yes	Yes
LDP-612	0	56.6	in H2O	0	0.17	28.3	28.48	56.6	56.782	± 0.283	Yes	Yes
LDP-701	0	115.8	in H2O	0	0.0052	57.9	57.897	115.8	115.789	± 0.579	Yes	Yes
LDP-801	0	6.971	in H2O	0	0.022	3.4855	3.507	6.971	6.994	± 0.035	Yes	Yes
LDP-802	0	57.08	in H2O	0	0.183	28.54	28.73	57.08	57.27	± 0.285	Yes	Yes
LDP-901	0	104.36	in H2O	0	0.0013	52.18	52.238	104.36	104.47	± 0.522	Yes	Yes
LDP-902	0	102.56	in H2O	0	0.0024	51.28	51.275	102.56	102.573	± 0.513	Yes	Yes
LDP-903	0	32.358	in H2O	0	0.00862	16.179	16.272	32.358	32.453	± 0.162	Yes	Yes
LDP-905	0	130.68	in H2O	0	0.388	65.34	65.737	130.68	131.096	± 0.653	Yes	Yes
LT-120	0	99	in H2O	0	-0.003	49.5	49.516	99	99.093	± 0.495	Yes	Yes
PT-001	0	600	psig	0	1.328	300	301.423	600	601.36	± 3	Yes	Yes
PT-002	0	500	psig	0	1.523	250	251.59	500	501.74	± 2.5	Yes	Yes
PT-003	10	20	psig	10	10.03	15	15.031	20	20.035	± 0.05	Yes	Yes
PT-009	0	300	psig	0	0.9064	150	150.944	300	300.982	± 1.5	Yes	Yes
PT-010	0	300	psig	0	0.8975	150	150.976	300	301.033	± 1.5	Yes	Yes
PT-101	0	500	psig	0	1.367	250	251.428	500	501.528	± 2.5	Yes	Yes
PT-102	0	10	psig	0	0.009	5	5.01	10	10.01	± 0.05	Yes	Yes

Test Engineer Signature _____ Date 7/25/03

Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
PT-103	0	10	psig	0	0.007	5	5.009	10	10.011	± 0.05	Yes	Yes
PT-104	0	500	psig	0	0.471	250	250.51	500	500.56	± 2.5	Yes	Yes
PT-107	0	500	psig	0	1.034	250	251	500	500.869	± 2.5	Yes	Yes
PT-108	0	500	psig	0	0.36	250	250.395	500	500.545	± 2.5	Yes	Yes
PT-109	0	500	psig	0	0.361	250	250.48	500	500.56	± 2.5	Yes	Yes
PT-110	0	10	psig	0	0.0072	5	5.008	10	10.011	± 0.05	Yes	Yes
PT-111	0	500	psig	0	0.41	250	250.5	500	500.5	± 2.5	Yes	Yes
PT-112	0	10	psig	0	0.0031	5	5.021	10	10.011	± 0.05	Yes	Yes
PT-113	0	500	psig	0	0.394	250	250.406	500	500.495	± 2.5	Yes	Yes
PT-201	0	500	psig	0	0.168	250	250.58	500	500.62	± 2.5	Yes	Yes
PT-202	0	500	psig	0	1.42	250	251.53	500	501.58	± 2.5	Yes	Yes
PT-203	0	500	psig	0	1.4383	250	251.55	500	501.55	± 2.5	Yes	Yes
PT-204	0	500	psig	0	1.6	250	251.7	500	501.8	± 2.5	Yes	Yes
PT-205	0	10	psig	0	0.03	5	5.03	10	10.03	± 0.05	Yes	Yes
PT-206	0	500	psig	0	1.488	250	251.567	500	501.646	± 2.5	Yes	Yes
PT-301	0	500	psig	0	-0.071	250	249.896	500	499.75	± 2.5	Yes	Yes
PT-302	0	500	psig	0	0.275	250	250.23	500	500.13	± 2.5	Yes	Yes
PT-401	0	300	psig	0	0.26	150	150.29	300	300.33	± 1.5	Yes	Yes
PT-402	0	300	psig	0	0.25	150	150.31	300	300.33	± 1.5	Yes	Yes
PT-501	0	500	psig	0	0.455	250	250.56	500	500.56	± 2.5	Yes	Yes
PT-502	0	500	psig	0	1.628	250	251.68	500	501.82	± 2.5	Yes	Yes
PT-602	300	400	psig	300	300.29	350	350.297	400	400.319	± 0.5	Yes	Yes
PT-603	0	10	psig	0	0.009	5	5.009	10	10.01	± 0.05	Yes	Yes
PT-604	0	500	psig	0	0.00218	250	249.972	500	499.692	± 2.5	Yes	Yes
PT-605	0	100	psig	0	-0.0019	50	50.07	100	99.992	± 0.5	Yes	Yes
PT-606	0	100	psig	0	-0.0022	50	49.619	100	99.259	± 0.5	No	Yes
PT-610	0	10	psig	0	0.001	5	5.012	10	10.013	± 0.05	Yes	Yes
PT-611	0	10	psig	0	0.007	5	5.008	10	10.01	± 0.05	Yes	Yes
PT-701	0	15	psig	0	-0.055	7.5	7.498	15	14.9997	± 0.075	Yes	Yes
PT-801	0	500	psig	0	1.026	250	251.002	500	500.69	± 2.5	Yes	Yes
PT-802	0	250	psig	0	0.005	125	125.436	250	250.8	± 1.25	Yes	Yes
PT-901	0	10	psig	0	0.001	5	5.001	10	10.01	± 0.05	Yes	Yes
PT-902	0	16	psig	0	0.00491	8	8.051	16	16.05	± 0.08	Yes	Yes
PT-905	0	20	psig	0	0.074	10	9.972	20	19.882	± 0.1	No	Yes

Test Engineer Signature J. L. Schulman Date 7/25/03

Tag	LRV	URV	Units	0%		50%		100%		Criteria (0.5%)	Criteria Met?	Logged Data File response?
				Desired	DAS	Desired	DAS	Desired	DAS			
Recheck of PT-605 and 905 after recalibration of Instrument Loop (see test Log)												
PT-605	0	100	psig	0	0.011	50	49.995	100	99.995	± 0.5	Yes	Yes
PT-905	0	20	psig	0	0.0013	10	9.9989	20	19.998	± 0.1	Yes	Yes

Test Engineer Signature _____ Date 7/25/03

TEST LOG

Procedure Number: OSU-D-05 Rev.: 0

Test Engineer: J.L. Schlaman Date: 7/15/03

Time	Comments
1000	Conducted pre test briefing with J. Groome and J. Hopson describing the test methodology and the type of plant responses that could be expected during this test. This test is expected to take several days to conduct and results and discrepancies will be noted on Appendix A and summerized in the test log.
1700	Secured Testing for the Day.
0700	7/16/03 Resumed testing.
1700	Secured Testing for the Day.
0700	7/17/03 Resumed testing
1800	Secured Testing for the Day
0700	7/18/03 Resumed Testing
1300	Secured testing for the Day
0700	7/21/03 Resumed testing.
0900	PT 605 was beyond the 100% (20 mA/5volt) acceptance criteria
1100	PT905 was beyond the 100% (20 mA/5volt) acceptance criteria
1700	Secured Testing for the Day

TEST LOG

Procedure Number: OSU-D-05 Rev.: 0

Test Engineer: J.L. Schlamann Date: 7/22/03

Time	Comments
0700	Resumed Testing
0900	Will simulate Vortex flow meter flow using a Fluke 789 meter
1800	Secured Testing for the Day
0700	7/23/03 Resumed Testing
	The KW meters are not setup for 0% (4mA/1 volt), 50% (12mA/3 volt) and 100% (20 mA/5 volt) signal. The following Table Depicts the actual values these meter were setup to
	KW 101 Zero 1.1171 volts and 4.442 mA
	50% 2.7196 volts and 10.182 mA
	100% 4.322 volts and 17.182 mA
	KW 102 Zero 1.0045 Volts and 4.0 mA
	50% 2.583 Volts and 10.290 mA
	100% 4.162 Volts and 16.58 mA
	KW 103 Zero 0.9786 Volts and 3.934 mA
	50% 2.936 Volts and 7.800 mA
	100% 4.8931 Volts and 19.743 mA

TEST LOG

Procedure Number: OSU-D-05 Rev.: 0

Test Engineer: J.L. Schlaman Date: 7/22/03

Time	Comments
	KW 104 Zero 0.9946 volts and 3.997 mA
	50% 2.9533 Volts and 11.874 mA
	100% 4.912 Volts and 19.743 mA
	KW 601 Zero 0.928 volts and 3.942 mA
	50% 2.963 volts and 11.892 mA
	100% 4.943 volts and 19.834 mA
1700	Secured Testing for the Day
0700	7/24/03 Resumed testing
0900	Confirmed that all HPS's are OOC.
1000	Reshot the loops for PT 905 and PT 605
	PT905 Zero 0.9963 changed to 1.0076 volts
	100% 5.0516 changed to 5.0276 volts
	PT605 Zero 0.9981 changed to 0.9972 volts
	100% 4.9742 changed to 4.9732 volts
	PT 905 and PT605 met acceptance criteria
	after loops were reshot.
1230	Secured testing after satisfactorily completing
	functional testing.
	No Further entries

J.L. Schlaman 7/25/03

OREGON STATE UNIVERSITY

DEPARTMENT OF NUCLEAR ENGINEERING

ADVANCED THERMAL HYDRAULIC RESEARCH LABORATORY

OSU-D-06

AP1000 EXPORT VERIFICATION & VALIDATION

Revision 0

6/10/03

John Hopson, Originator
Research Assistant
Date

6/10/03

John Groome, Reviewer
Facility Operations Manager
Research Assistant
Date

6/10/03

Jose Reyes
Program Manager
Professor
Date

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Attachments

Attachment A – AP1000 Export On-Line Help Document
Attachment B – AP1000 Export Source Code

1.0 OBJECTIVES

The objective of this Verification & Validation (V&V) procedure is to confirm that AP1000Export satisfactorily creates test data files for subsequent analysis and long-term storage. For this procedure, all three export formats will be tested: ASCII text file, MS Excel™ and the Platform Independent Binary (PIB).

2.0 REFERENCES

2.1 AP1000Export Help.htm document (attached)

2.2 Source code (attached)

3.0 PREREQUISITES

NOTE: Prerequisites assume test engineer has successfully installed AP1000Export according to the On-Line Help document and has available test data.

STEP 3.1 [V] Historical data has been logged during a particular test.

STEP 3.2 [V] Citadel data fold has been properly archived to the source computer.

STEP 3.3 [V] AP1000 Export and supporting NRC files have been properly installed.

Version: 2.0.1283

STEP 3.4 [V] AP1000 database includes the corresponding Test Name, Start and End Time.

Test Name: NRC-AP1000-01

Start Time: 6/5/2003 13:18:07

End Time: 6/5/2003 14:36:00

4.0 INSTRUCTIONS

STEP 4.1 ☑ Launch **AP1000EXPORT.EXE**

STEP 4.2 ☑ Click **Export Process Data.**

STEP 4.3 ☑ Randomly select 20 tags to validate. Click **Next.**

1 DP-111	2 DP-401	3 FDP-604	4 FMM-001
5 FMM-905	6 FVM-001	7 FVM-002	8 HPS-801-2
9 KW-101	10 KW-102	11 LCT-701	12 LCT-901
13 LDP-001	14 LDP-127	15 LT-120	16 PT-001
17 TF-101-1.30-2	18 TH-604	19 TR-001-1	20 TW-905

STEP 4.4 ☑ Select Test as recorded in Step 3.4. Click **Next.**

STEP 4.5 ☑ Choose desired Retrieval options and document in Test Log. Click **Next.**

STEP 4.6 ☑ Ensure that the check box "Close when complete" is <u>not</u> checked.

STEP 4.7 ☑ Choose the **ASCII text file** destination option.

STEP 4.8 ☑ Click **Export** to begin the task.

STEP 4.9 ☑ When the Save As dialog box appears, enter filename: NRC-AP1000-01.TXT.

STEP 4.10 ☑ Choose the **MS Excel >>** destination option.

STEP 4.11 ☑ Click **Export** to begin the task. MS Excel™ will automatically launch. Save file as filename: NRC-AP1000-01.XLS.

STEP 4.12 ☑ Choose the **NRC Databank** file destination option.

STEP 4.13 ☑ Click **Export** to begin the task.

STEP 4.14 ☑ When the Save As dialog box appears, enter filename: NRC-AP1000-01.BIN

STEP 4.15 ☑ Upon completion, close AP1000Export.

STEP 4.16 ☑ Double-click **startxwin.bat** to launch X-Windows.

STEP 4.17 ☑ Position the Bash window on the upper-left corner.

STEP 4.18 ☑ Launch AcGrace by typing the following in the Bash window:

```
$ cd /usr/local/acgrace/bin
$ acgrace.bat
```

STEP 4.19 ☑ Position the new window and expand to show the complete chart.

STEP 4.20 ☑ Click **File-> Read->Databank data.**

STEP 4.21 ☑ Browse to the desired data file as entered in Step 4.14. Click **OK** to continue.

STEP 4.22 ☑ Start at the top of the channel list and select the first channel.

STEP 4.23 ☑ Select **British** Units Type and then click **Accept.**

STEP 4.24 ☑ Confirm channel shows the correct number of samples (X-Axis) and correct unit description (Y-Axis).

STEP 4.25 ☑ Repeat Steps 4.23 -> 4.24 for each additional channel until all channels are shown.

STEP 4.26 ☑ From the menu bar, click **Data->Export->ASCII.**

STEP 4.27 ☑ Select the desired Write Set (channels to be exported), enter filename: Dump.txt and click OK to export data. Note: You may need to break-up the file if rows exceed the Excel maximum of 65,000 rows.

STEP 4.28 ☑ Using National Instruments Measurement and Automation Explorer (MAX) export the same tags, time period and resolution to filename: MAXDump.txt. Ensure that interpolation mode is set for Step before exporting. This data shall be considered actual data for validation purposes.

5.0 ACCEPTANCE CRITERIA

STEP 5.1 ☑ All steps completed satisfactorily. Any deviation from the procedure is documented in the Test Log.

STEP 5.2 ☑ All AcGrace plots show correct number of samples (X-Axis) and correct unit description (Y-Axis). Document any discrepancies in the Test Log.

STEP 5.3 ☑ Visually inspect data from the three output files. Confirm that the data matches exactly for each channel based on number of data rows, units and data values.

STEP 5.4 ☑ Determine deviation error between AcGrace and MAX output files. Confirm that the error is less then +/- 0.05 % of span for each channel data value. Document any discrepancies in the Test Log.

STEP 5.5 ☑ Plot any ~~ten~~ eight trends comparing AcGrace and MAX data, and include them with this document. (Nine plots shown.)

ACCEPTANCE CRITERIA MET

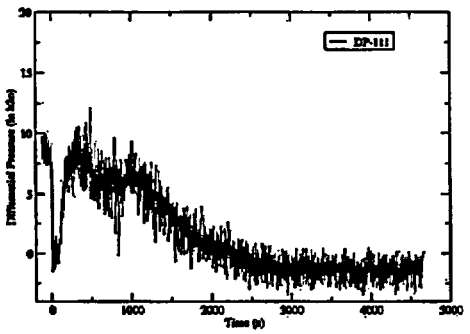
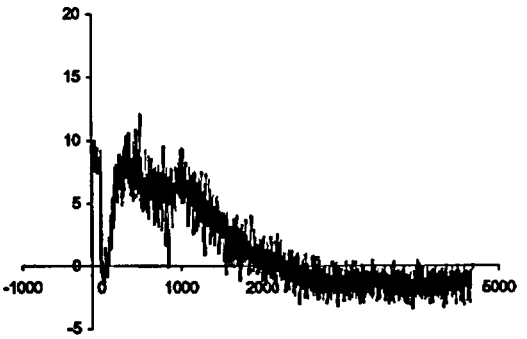
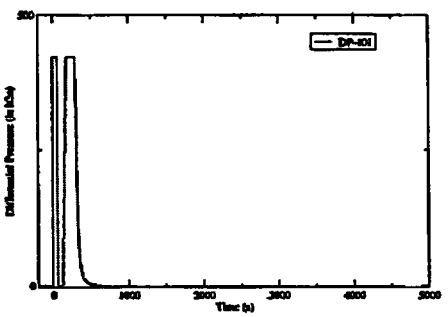
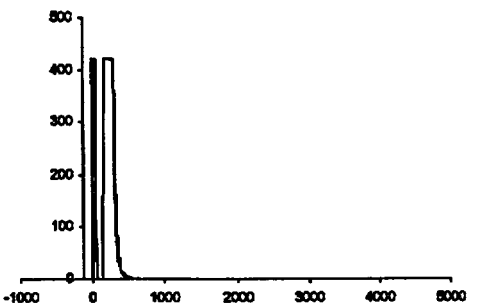
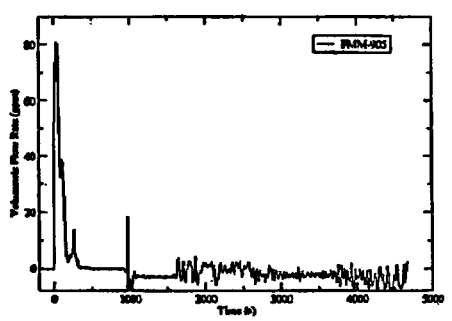
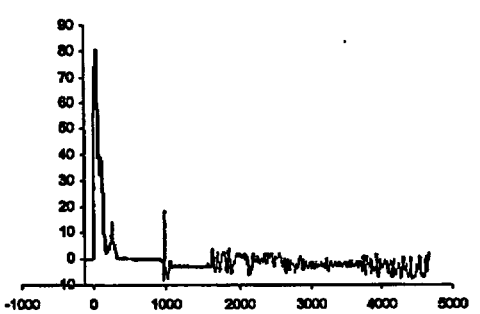
John A. Hopson	[signature]	6/10/03
Test Engineer Name	Test Engineer Signature	Date

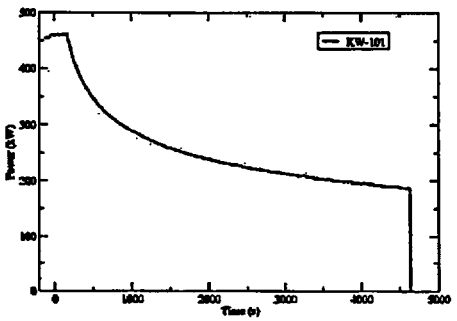
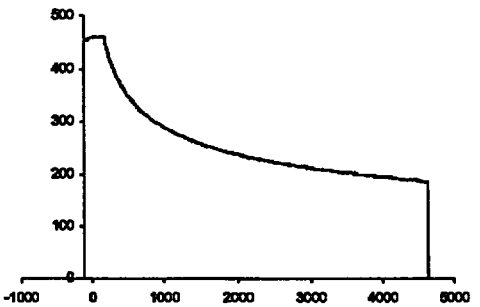
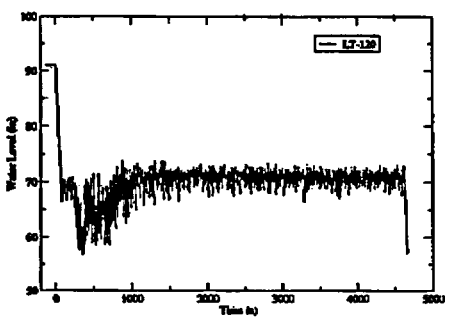
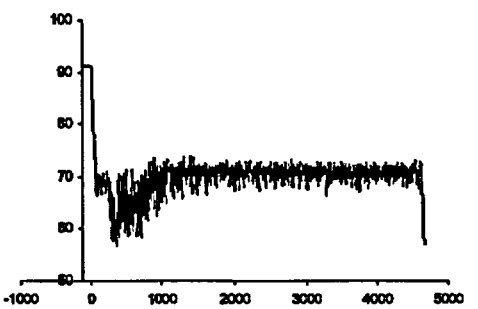
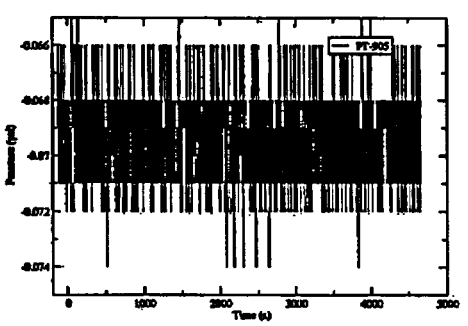
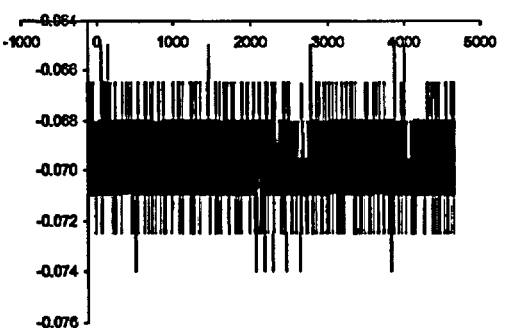
Comments:

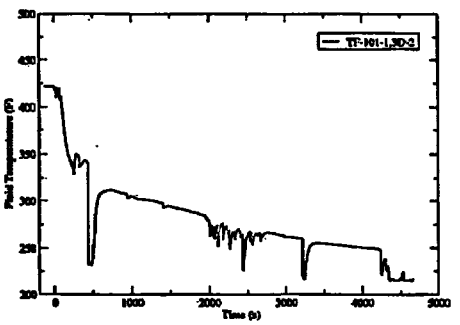
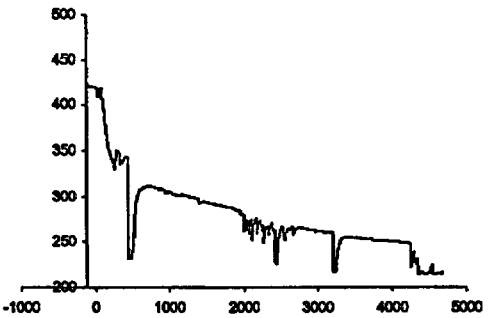
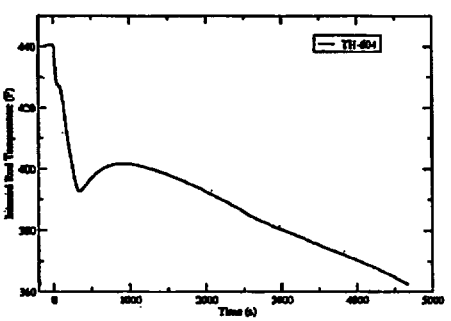
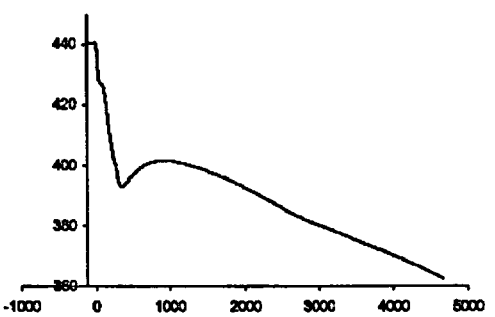
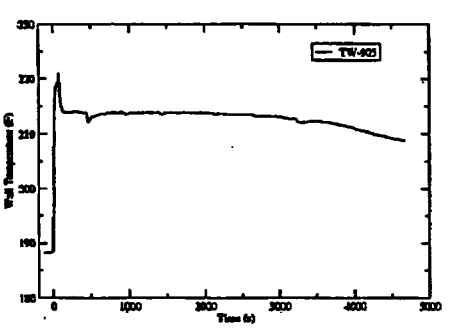
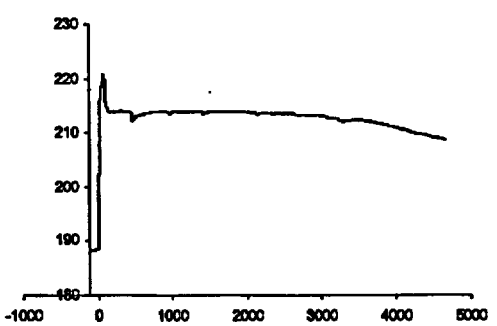
Step 4.24 - All 20 channels were verified with correct number of samples and correct unit description.

Output files from Steps 4.27 and 4.28 were merged into common Excel workbook, AP1000Export V&V.xls and saved to accompanying CD.

6.0 COMPARISON PLOTS

DP-111 (AcGrace)	DP-111 (MAX)
	
DP-401 (AcGrace)	**DP-401 (MAX)**
	
FMM-905 (AcGrace)	**FMM-905 (MAX)**
	

KW-101* (AcGrace) *AcGrace plot is shown in SI Units (KW) for KW-101	KW-101 (MAX)
	
LT-120 (AcGrace)	**LT-120 (MAX)**
	
PT-905 (AcGrace)	**PT-905 (MAX)**
	

TF-101 (AcGrace)	TF-101 (MAX)
	
TH-604 (AcGrace)	**TH-604 (MAX)**
	
TW-905 (AcGrace)	**TW-905 (MAX)**
	

TEST LOG

Procedure Number: OSU-D-06 Rev.: D

Test Engineer: John Hopson Date: 6/10/03

Time	Comments
9:00 AM	Logged on to computer JOHNHOI, which has AP1000 Expert
	2.0 v. 2.0.1283 installed.
	Sect. 3.4 Chose existing test NRC-AP1000-01.
	Sect. 4.3 Chose tags so that at least one from each
	group is included in the validation.
	Sect. 4.5. Retrieval Options Selected:
	• Interval Time = 1 second
	• Include Header = Yes
	• Include Actual Timestamps = No
	• Include Interval = Yes
	• Start at T = -120 seconds = Yes (Query two minutes before)
	• Replace blank (Null) with "NaN" = No
	• NRC Databank units
	Sect. 4.8 Saved ASCII file as NRC-AP1000-01.TXT
	Sect. 4.10 Saved Excel Workbook as NRC-AP1000-01.XLS
	Set. 4.12 Saved NRC Databank file as NRC-AP1000-01.BIN

TEST LOG

Procedure Number: OSU-D-06 Rev.: 0

Test Engineer: John Hopson Date: 6/10/03

Time	Comments
	4.1B Launched AcGrace version 5.1.12C. Read Databank
	and confirmed plots per Sec. 4.24
	4.27 Exported AcGrace data plots into Excel,
	Filename AP1000Export V1V.xls, Used comma and
	space as delimiters.
	4.28 Launched NI Max version 2.2.0.310 with DSC
	Module 6.1 installed. Opened NRC-AP1000-01 data folder
	and Exported results for the 20 tags and time period.
	* start time = 6/5/2003 1:16:07 PM
	End time = 6/5/2003 2:36:00 PM
	* start time adjusted to account for T=-120sec
	Retrieval option.
	Results: Section 5. Aggregated results in Excel workbook
	and compared AcGrace to NI Max Data. No data
	difference exceeds Acceptance criteria. All data passed.
10:30 AM	No further entries.

Attachment A
AP1000 Export On-Line Help Document

AP1000Export 2.0
July 14, 2003

J. Hopson
Department of Nuclear Engineering & Radiation Health Physics

Welcome
- What is AP1000Export?
- Data Access
- General Procedure

Getting Started
- System Requirements
- Installing AP1000Export
- Introducing the Toolbar
- Configuring the Database
- Installing NRC Databank files

Data Storage Process
- Before the Test
- Running the Test
- Stopping the Test
- Moving Data to the Radiation Center network

All about Exporting
- Exporting Tag details
- Exporting Test Schedule
- Exporting Sequence of Events (SOE data)
- Exporting Process data
- Validating NRC Databank binary files

Administration
- What you need to do
- Architecture
- Components
- Updating the Tags Table
- Updating the Tests Table
- Truncating the SOE/Alarms database
- Troubleshooting

Sequence of Events (SOE): A Sequence of Events export is an event/alarm list from the ALRMDB Database. It provides a log of test progress and usually complements the time-series data.

NOTE: The SOE database is not yet integrated with this release. The "Export SOE data" task is therefore currently disabled.

Time-series data: A time-series data export is an interval-based snap-shot of process values from the Citadel Database. These data points can then be plotted to view trends and dynamics.

You may choose to include timestamps and/or an interval mark. Timestamps provide the actual time (in Military time format) when the data was stored. An interval mark provides a column of seconds since the beginning of the test. For example, -120 indicates a time interval two minutes before the start of the test. Keep in mind that the control system is configured to count down 120 seconds when the operator presses the Test push button. After the 120 delay has expired, the interval mark will begin counting from T=0 seconds.

Timestamp	Interval Sec	DP-111 Diff Press (in H2O)	DP-114 Diff Press (in H2O)	LDP-127 Liquid Level (in)
05/01/2003 15:07:02	0	9.105	5.861	103.917
05/01/2003 15:08:02	60	-.759	5.344	39.061
05/01/2003 15:09:02	120	1.550	6.723	37.630

General Procedure

The following is a general procedure how APEX stores and retrieves data.

1. **Acquire data:** Process data is stored every second. That means a snap shot is taken once per second for all channels and saved to a database. National Instruments Citadel Database is used to store time-series data. SOE data is stored to another database (via Wonderware) as events occur. Both are considered real-time data storage. Data logging continues for the full duration of the test. Test Start and End times are also recorded so that we can easily select the time period for subsequent analysis.

2. **Archive data:** At the end of the test, the Citadel database is archived based on the test name. This creates individual folders, one for each test. This new Citadel database folder is then copied to a storage media so that it can be moved to the Radiation Center network. Students and faculty are then able to query this data from their desktop computers.

3. **Retrieve data:** Test data is stored in compressed binary files that support ANSI-92 Structured Query Language (SQL). This permits a number of client tools to easily retrieve data. The two most common tools within the APEX department are National Instruments DIAdem™ and AP1000Export. Diadem is a spreadsheet/trending package designed specifically for large channel counts within the National Instruments data acquisition system. AP1000Export is an in-house application that provides data formatting and flexibility to create test files for sponsors and 3rd party software applications.

Getting Started

Before you can use AP1000Export, you need to install some software and configure database connections. Follow these instructions to properly install AP1000Export on your computer.

System Requirements

Make sure your computer meets these minimum requirements:

- Pentium III, 266 KHz processor
- Windows 98, Windows NT 4.0 SP 6a, Windows 2000 or Windows XP
- 256MB RAM
- 1024x768 32-bit color resolution monitor

the Quit command can be accessed by pressing Alt+Q.

Configuring the Database

AP1000Export acquires data from multiple sources. Before you can start retrieving data, you need to tell AP1000Export where these databases are located.

1. From the desktop, double-click the AP1000Export shortcut.
2. Under Pick a task, click **Configure Database.**
3. Enter the name of the SQL Server. Example syntax is `johnh01\VSdotNET`.
4. From the drop-down list, select the ODBC Driver name for the National Instruments Logos program. For this release, use `National Instruments Citadel 4 Database`.

NOTE: AP100Export requires National Instruments Logos™ version 4.4 to be installed on your computer. This provides special services and an ODBC driver to access data files.

5. Enter the Data directory where the Citadel database folders are located. Syntax depends where the database folders are physically located. If they are located on the same computer, the folders are considered Local. If they are located on another computer, say on a dedicated server, the folders are considered Remote.

   Example Local syntax: `d:\historian`
   Example Remote syntax: `\\johnh01\d\historian`

6. Enter the URL tag prefix. This prefix is required to properly query the Citadel database. It will be removed from each tag when exporting. Example syntax is `\\apex02\AP1000\`.
7. Click **Save.**

Installing NRC Databank files

Data maintained in the USNRC Data Bank consist of large time-dependent data files containing the results of numerous experimental tests. The Platform Independent Binary (PIB) file structure is the preferred format to archive these experimental tests and to properly view trends using a program called AcGrace. AP1000Export is able to create these PIB files with the help of some special PERL scripts. Follow the procedure below to install these scripts and supporting software.

1. Create the following folders. Keep in mind that you must have a `D:\` drive on the computer.

   ```
   D:\Databank\data
   D:\Databank\Testdata
   D:\Databank\Scripts
   D:\Databank\Raw
   D:\Databank\Channel
   D:\Databank\TWX
   ```

2. Copy all the files from the Scripts folder (see Administrator for location) to your local `D:\Databank\Scripts` directory. These scripts were originally created by Robert Beaton at Information Systems Laboratories (ISL, Inc.) and have been modified to work with the AP1000 system.
3. Install Cygwin tools. Cygwin tools are available at no cost from http://www.cygwin.com. The default installation should provide sufficient functionality.
4. Install Cygwin PERL v5.6.1. PERL is available at no cost from the Cygwin website.
5. Install AcGrace v5.1.12C. Acgrace is available at no cost from http://www.acgracehome.org/acgrace/download/index.jsp.

IMPORTANT: Make sure you download the correct AcGrace version because the software vendor has

Running the Test

Follow this procedure to log data during a Test.

1. From the AP1000 Engine Manager VI application, check the box **Log Data**. Best practice is to only log data when absolutely necessary because retrieval time is highly dependent on the amount of data archived. Keeping the data folders as small as possible will make retrieval much more responsive.
2. When you are ready to begin the test, press the Test Start push button on the APEX control panel. After the control system counts down from T=-120 seconds, the event will occur and the actual Start time will be recorded to the AP1000 database.

The task to export the test schedule allows you to retrieve a schedule of all tests executed in the APEX facility.

1. Click **Export Test schedule.**
2. Choose the destination option: ASCII file or directly into Microsoft Excel.
3. Check the box to **Close when complete** if you want AP1000Export to automatically close when the task completes.
4. Click **Export** to begin the task.

Exporting Sequence of Events (SOE data)

The task to export Sequence of Events is currently not available with this release.

Exporting Process data

The task to export process data allows you to retrieve time-series data points for trending and confirmatory analysis.

1. Click **Export Process data.**
2. Select the desired Test and click **Next** to continue.
3. Select tags you want to include in the query. You can enter a filter to quickly add tags. Use a coma to separate tags and a % as a wild card. For example, "`LDP%, TF-1%`" will add all tags starting with LDP and TF-1, respectively. If you need to reload all tags, press Reload or enter "%" as a filter. Remove tags by selecting them in the list and pressing Delete. Click **Next** to continue.
4. Choose appropriate retrieval options. If you check the box to include a Time Interval and the chosen time interval is two minutes or less, you may also check the box to change the query start time to 120 seconds before the test (Start at T= -120 seconds). Refer to the table below for preferred settings:

Retrieval Options	DIAdem™	Westinghouse	USNRC
Interval		1 second	1 second
Include Header	No	Yes	No
Include actual timestamps	No	Yes	No
Include Time Interval	Yes	Yes	Yes
Start at T= -120 seconds		Yes	Yes
Replace blank (Null) values with "NaN"	No	Yes	No
Units format	Simple Units	Simple Units	NRC Databank

Click **Next** to continue.

5. Choose the destination option: ASCII file, directly into Microsoft Excel™ or NRC Databank file.

> NOTE: Creating NRC Databank files requires additional software and configuration. Refer to Installing NRC Databank files for more information.

6. Check the box to **Close when complete** if you want AP1000Export to automatically close when the task completes.
7. Click **Export** to begin the task.

Validating NRC Databank binary files

You should view exported NRC Databank files to ensure that the conversion process was successful. Viewing these files requires the NRC Analysis Code version of Grace (AcGrace). Follow these instructions to plot AP1000 data.

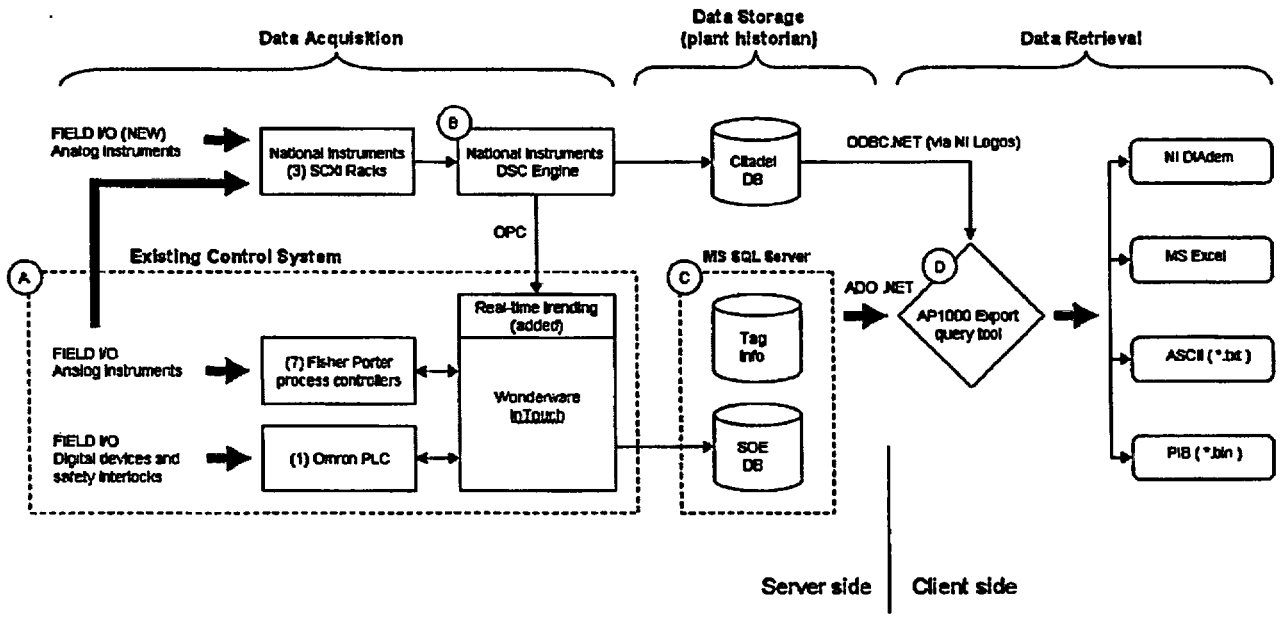
1. Double-click **startxwin.bat.** This file should be located in the directory `c:\cygwin\usrX11R6\bin`. This will launch X-windows.
2. Position the Bash window on the upper-left corner.

Architecture

The APEX data acquisition and storage system currently supports more than 620 field instruments. These instruments provide key physical dynamics for each test, such as temperature, pressure and water level. An off-the-shelf hardware/software package from National Instruments (Austin, TX) acquires data from field instruments and stores them in a database Citadel. Citadel is currently configured for a maximum storage rate of one Hertz.

AP1000Export is capable of querying this database and generating the preferred data file format. Another benefit of separating the storage and retrieval task is that the retrieval interval is now independent of the original storage rate. In other words, AP1000Export is able to query the database for any desired resolution (say, every two seconds or perhaps every ten minutes) rather than the interval at which the data was stored.

To aid in the query process and provide context to the time-series data, such as test schedule and tag units, additional databases have been incorporated into the system. The architecture diagram is shown below:



A. Existing analog tapped and pulled to the new DAS.

B. NI DSC Engine sends data to the Citadel Database and provides OPC connectivity to the Wonderware application so that new analog instruments can be viewed within the existing system.

C. Tag information and SOE data are stored in MS SQL Server databases. Tag information is imported by running a Data Transformation Services (DTS) script on a DAS configuration file called SCFExport.txt.

D. AP1000Export is a scalable .NET Framework query tool that combines the multiple data sources and exports data to the desired format.

The system leverages Microsoft SQL Server™ to provide context to Citadel process data. SQL Server also provides a layer of protection as users do not directly interact with the data acquisition hardware per APEX Quality Assurance guidelines.

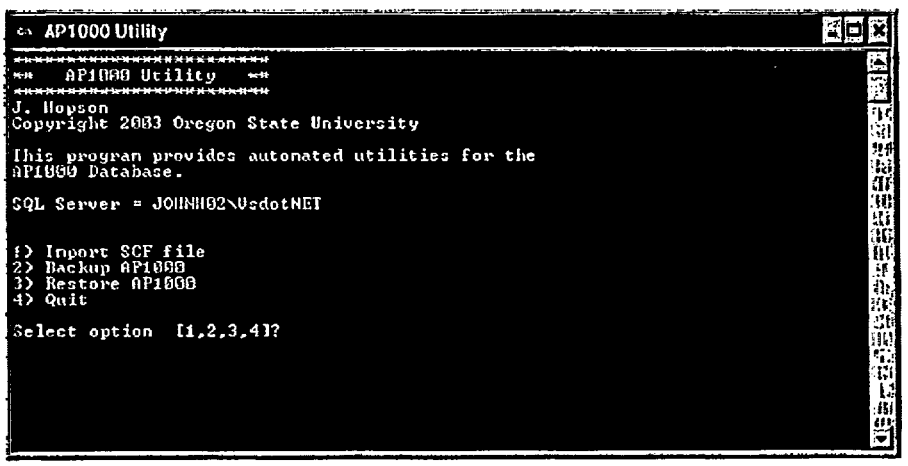
Components

AP1000Export is just one component that makes up the data acquisition, storage and retrieval system. The following components are specifically required for AP1000Export to function properly:

Component	Description

data acquisition system. This ensures that the two systems are always synchronized. An MS-DOS command batch file called **AP1000Utility.bat** is available to easily perform this procedure.

1. On the DAS computer, launch National Instruments LABView 6.1 and open a VI. The particular VI to open does not really matter.
2. From the Tools menu bar, click **Datalogging & Supervisory Control** and then select **Configure Tags**. This will launch the Tag Configuration Editor. You may close the VI at this time.
3. Make any necessary changes and remember to save the file as AP1000.SCF.
4. Click **File** on the menu bar and then click **Export**. The Export dialog will appear.
5. Browse for the SCFExport.txt file.
6. Click OK to export the current configuration to SCFExport.txt.
7. Close the Tag Configuration Editor.
8. Double-click the Batch file AP1000Utility.bat.
9. Confirm that the SQL Server name is correct.



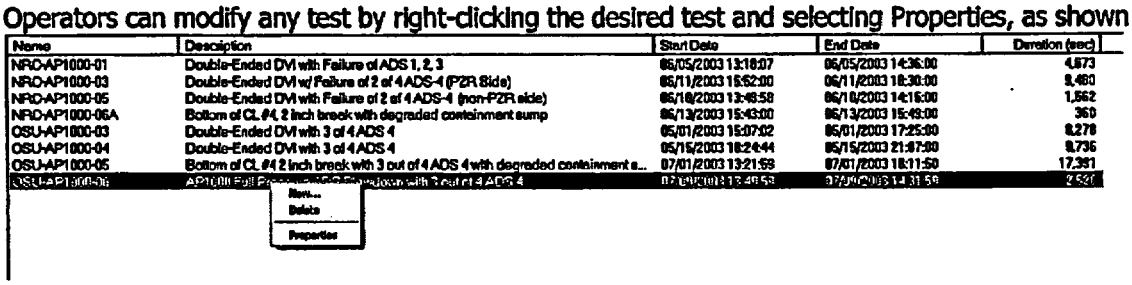
10. Press **[1] Import SCF file**. The batch file will execute a DTS package call SCF_TO_AP1000 and import the SCFExport.txt file.
11. When the import successfully completes, press **[4] Quit** and close the MS-DOS console.

IMPORTANT: Try to avoid renaming or removing tags from the data acquisition system. Removed tags are no longer available within AP1000Export. Consequently, you will not be able to query data from past tests for this particular tag.

Updating the Tests Table

The Tests Table resides in the AP1000 database. It maintains a list of tests and associated information like start and end times. This provides an easy time boundary when querying data for a particular test. Test schedules are created within the Wonderware InTouch™ application using an ActiveX Control called TestManager.ocx. TestManager enables the operator to enter test name and description at the beginning of each test. It then receives Start and End timestamps from the control system.

Operators can modify any test by right-clicking the desired test and selecting Properties, as shown below.



Attachment B
AP1000 Export Source Code

```
' ##########################################################################
' ##          AP1000Export- Oregon State University                       ##
' ##                        John A. Hopson                                ##
' ##             Initial release: April 24, 2003                          ##
' ##########################################################################

Option Strict Off 'This module uses late binding to generically assign drReader after ↙
    ExecuteSQL completes.

Imports System.Data.OleDb
Imports System.IO
Imports Microsoft.Data.Odbc

Module Module1
    Public frmExport As New Export()
    Public sClickPath As String
    Public bSaving As Boolean
    Public bUserCancel As Boolean
    Public NullCount As Long
    Public iInterval As Short
    Public sServername As String
    Public sODBCDriver As String
    Public sDataDir As String
    Public sURL As String
    Public sTitle As String
    Public dtStartDate As Date
    Public dtEndDate As Date
    Public CitadelString As String
    Public SQLString As String
    Public StartDate As Date
    Public EndDate As Date
    Public iPos As Integer
    Public Const DATABASE_NAME As String = "AP1000"
    Public Const DATABANK_RAWFILE = "D:\Databank\Raw\Test001.txt"   'Defines where to ↙
    place ASCII file for MakeBinary.bat
    Public Const CANCELED = 0
    Public Const COMPLETED = 1
    Public Const ABORTED = 2
    Public drReader As Object
    Public ErrMsg As String

    Sub Main()
        ' GetPath to click wave
        sClickPath = Replace(System.Reflection.Assembly.GetExecutingAssembly.Location, " ↙
    AP1000Export.exe", "Clickerx.wav")

        frmExport.ShowDialog()
    End Sub

    Sub LogError(ByVal e As Exception, ByVal sMessage As String)
        Dim LogMsg As StringWriter = New StringWriter()
        ErrMsg = e.Message

        MsgBox(ErrMsg & vbCrLf & sMessage, MsgBoxStyle.Critical)
        LogMsg.WriteLine("Source: " & e.Source)
        LogMsg.WriteLine("Message: " & ErrMsg)
        LogMsg.WriteLine(sMessage)

        'Write error to event log
        System.Diagnostics.EventLog.WriteEntry("AP1000Export", _
        LogMsg.ToString, Diagnostics.EventLogEntryType.Error)
    End Sub

    Function GetTags(ByVal sFilter As String) As Boolean
        Dim r As Integer = 0
```

```
            frmExport.Cursor = System.Windows.Forms.Cursors.Default
            Return True

        Else
            ' Change mouse cursor to Waiting
            frmExport.Cursor = System.Windows.Forms.Cursors.Default
            Return False
        End If
    End Function

    Function ProcessToFile(ByVal sFilename As String, ByVal NRC_Default As Boolean) As
    Short
        Dim r As Integer
        Dim sw As StreamWriter
        Dim AddHeader As Boolean = frmExport.chkHeader.Checked
        Dim AddTimestamp As Boolean = frmExport.chkTimestamp.Checked
        Dim AddInterval As Boolean = frmExport.chkInterval.Checked
        Dim AddOffset As Boolean = (frmExport.chkOffset.Enabled And frmExport.chkOffset.
    Checked)
        Dim ShowNaN As Boolean = frmExport.chkShowNaN.Checked

        ' Apply NRC defaults if file is for NRC Databank
        If NRC_Default Then
            AddHeader = False
            AddTimestamp = False
            AddInterval = True
        End If

        'Make sure drReader object is reset so it can be assigned a new Type.
        drReader = Nothing

        'Show Wait mouse
        frmExport.Cursor = System.Windows.Forms.Cursors.WaitCursor
        frmExport.txtSummary.Cursor = System.Windows.Forms.Cursors.WaitCursor

        'Initialize Values
        bSaving = True
        bUserCancel = False
        NullCount = 0
        iPos = 0
        frmExport.ProgressBar1.Value = 0

        'Build SQL String
        CitadelString = BuildSQLString(frmExport.lvTags.Items.Count)

        frmExport.txtSummary.Text += "Querying Citadel..." & vbCrLf
        frmExport.Refresh()

        If Not ExecuteODBC(CitadelString, drReader) Then
            bSaving = False
            Return ABORTED
        End If

        Call BeginExport("Writing data to " & sFilename & "...")

        Try

            sw = File.CreateText(sFilename)
            sw.WriteLine(BuildHeader(AddHeader, AddTimestamp, AddInterval))

        Catch e As Exception
            Call LogError(e, "Result: Open file failed.")
            bSaving = False
            Return ABORTED
        End Try
```

```
        'Write header
        If AddHeader Then
            TxtString = sTitle
            TxtString += "File created on " & Format(Now, "MM/dd/yyyy HH:mm:ss") & vbCrLf↙
    & vbCrLf
        End If

        'Write column fields
        If AddTimestamp Then
            TxtString += "Timestamp" & vbTab
        End If

        If AddInterval Then
            TxtString += "Interval" & vbTab
        End If

        TxtString += frmExport.lvTags.Items(0).Text

        For r = 1 To frmExport.lvTags.Items.Count - 1
            TxtString += vbTab & frmExport.lvTags.Items(r).Text
        Next r

        TxtString += vbCrLf

        'Write Units
        If AddTimestamp Then
            TxtString += vbTab
        End If

        If AddInterval Then
            TxtString += "(sec)" & vbTab
        End If

        TxtString += GetUnits(frmExport.lvTags.Items(0).SubItems(1).Text)

        For r = 1 To frmExport.lvTags.Items.Count - 1
            TxtString += vbTab & GetUnits(frmExport.lvTags.Items(r).SubItems(1).Text)
        Next r

        Return TxtString
    End Function

    Function BuildSQLString(ByVal iTagCount As Integer) As String
        Dim r As Integer
        Dim sInterval As String
        Dim sStartDate As String
        Dim sEndDate As String
        Dim TagString As String

        frmExport.txtSummary.Text += "Building SQL string for " & iTagCount & " tags..." ↙
    & vbCrLf
        frmExport.Refresh()

        sStartDate = Format(StartDate, "MM/dd/yyyy HH:mm:ss")
        sEndDate = Format(EndDate, "MM/dd/yyyy HH:mm:ss")
        sInterval = iInterval / 86400

        ' Citadel Transform "SYNC{}" is used to prevent interpolation between data points↙
    .
        ' We also need to include single quotes for those tags with "." in their name
        If InStr(frmExport.lvTags.Items(0).Text, ".") = 0 Then
            TagString = """SYNC{" & sURL & frmExport.lvTags.Items(0).Text & "}"""
        Else
            TagString = """SYNC{" & sURL & "'" & frmExport.lvTags.Items(0).Text & "'" & "↙
    }"""
```

```
            myConnection.Open()

            'Set the command type
            myCommand.CommandType = CommandType.StoredProcedure

            'Open the Data Reader
            DataReader = myCommand.ExecuteReader
            Return True

        Catch e As OleDbException
            Call LogError(e, "Result: Stored Procedure " & SProcName & " failed.")
            Return False

        End Try
    End Function

    Function ExecuteODBC(ByVal SQLString As String, ByRef DataReader As OdbcDataReader)
    As Boolean
        Dim sDataPath As String

        'Create complete path to desired Citadel data directory
        sDataPath = sDataDir & "\" & frmExport.lvTests.SelectedItems(0).Text

        'Assemble the connection string
        Dim strConnection As String = _
        "Driver={" & sODBCDriver & "};" & _
        "MaxColumnNameLength=62;" & _
        "DbAppCharMap=@;" & _
        "CitadelCharMap=.;" & _
        "ConvertSpecialChars=1;" & _
        "DaylightSavings=OS;" & _
        "UTCBiasMinutes=OS;" & _
        "DataDirectory=" & sDataPath

        'Create a new connection object
        Dim myConnection As New OdbcConnection(strConnection)
        Dim myCommand As New OdbcCommand(SQLString)
        myCommand.Connection = myConnection

        Try
            'Open the connection
            myConnection.Open()

            'Open the Data Reader
            DataReader = myCommand.ExecuteReader
            Return True

        Catch e As OdbcException
            Call LogError(e, "Result: ExecuteSQL failed.")
            Return False

        End Try
    End Function

    Sub BeginExport(ByVal sMessage As String)
        frmExport.txtSummary.Text += sMessage & vbCrLf
        frmExport.Refresh()

        ' Show normal mouse (user may cancel write operation)
        frmExport.Cursor = System.Windows.Forms.Cursors.Default
        frmExport.txtSummary.Cursor = System.Windows.Forms.Cursors.Default
        frmExport.cmdExport.Text = "Cancel"
    End Sub

    Function BuildWhereClause(ByVal sFilter As String)
        Dim r As Short = 1
```

```
            End If
        Next i
        ExtractElement = ""
    End Function

    Function TagsToFile(ByVal sFilename As String) As Short
        Dim r As Integer
        Dim Params() As OleDbParameter
        Dim sw As StreamWriter

        'Make sure drReader object is reset so it can be assigned a new Type.
        drReader = Nothing

        'Show Wait mouse
        frmExport.Cursor = System.Windows.Forms.Cursors.WaitCursor
        frmExport.txtSummary.Cursor = System.Windows.Forms.Cursors.WaitCursor

        'Initialize Values
        bSaving = True
        bUserCancel = False
        NullCount = 0
        iPos = 0
        frmExport.ProgressBar1.Value = 0

        frmExport.txtSummary.Text += "Querying " & sServername & "..." & vbCrLf
        frmExport.Refresh()

        If Not ExecuteSP("jah_GetAllTags", Params, drReader) Then
            bSaving = False
            Return ABORTED
        End If

        Call BeginExport("Writing data to " & sFilename & "...")

        Try
            sw = File.CreateText(sFilename)

            'Write header
            sw.WriteLine("AP1000 Tag Details")
            sw.WriteLine("Oregon State University")
            sw.WriteLine("File created on " & Format(Now, "MM/dd/yyyy HH:mm:ss"))
            sw.WriteLine("")

            'Get Field names
            sw.Write(drReader.GetName(0))
            For r = 1 To drReader.FieldCount - 1
                sw.Write(vbTab & drReader.GetName(r))
            Next

            sw.Write(vbCrLf)

        Catch e As Exception
            Call LogError(e, "Result: Open file failed.")
            bSaving = False
            Return ABORTED
        End Try

        Do While drReader.Read
            sw.Write(drReader.GetValue(0))

            For r = 1 To drReader.FieldCount - 1
                sw.Write(vbTab & drReader.GetValue(r))
            Next

            sw.Write(vbCrLf)
            iPos += 1
```

```
            Return ABORTED
        End Try

        Do While drReader.Read
            sw.Write(drReader.GetValue(0))
            sw.Write(vbTab & drReader.GetValue(1))
            sw.Write(vbTab)
            If Not IsDBNull(drReader.GetValue(2)) Then sw.Write(Format(drReader.GetValue(↙
    2), "MM/dd/yyyy HH:mm:ss"))
            sw.Write(vbTab)
            If Not IsDBNull(drReader.GetValue(3)) Then sw.Write(Format(drReader.GetValue(↙
    3), "MM/dd/yyyy HH:mm:ss"))
            sw.Write(vbTab)
            If Not IsDBNull(drReader.GetValue(4)) Then sw.Write(Format(drReader.GetValue(↙
    4), "#,##0"))

            iPos += 1
            sw.Write(vbCrLf)

            System.Windows.Forms.Application.DoEvents()
            If bUserCancel Then
                'Close data file
                If Not sw Is Nothing Then sw.Close()
                frmExport.cmdExport.Text = "Export"
                bSaving = False
                Return CANCELED
            End If
        Loop

        'Okay, so now we know what the total rows retrieved
        frmExport.ProgressBar1.Maximum = iPos
        frmExport.ProgressBar1.Value = iPos

        'Close data file
        If Not sw Is Nothing Then sw.Close()
        frmExport.cmdExport.Text = "Export"
        bSaving = False
        Beep()
        Return COMPLETED
    End Function

    Function GetUnits(ByVal sUnits As String) As String
        'Extract units if Simple Units selected and not exporting to NRC file.
        If frmExport.optSimpleUnits.Checked And Not frmExport.optNRC.Checked Then
            sUnits = ExtractElement(sUnits, 2, "(")
            sUnits = "(" & sUnits
        End If

        Return sUnits

    End Function
End Module
```

```
'This module is dedicated to Excel interaction.
Imports System.Data.OleDb

Module Module2
    Dim xlApp As Excel.Application
    Dim xlBook As Excel.Workbook
    Dim xlSheet As Excel.Worksheet
    Const MAX_DATA As Integer = 2048000 'Maximum data points (total) for Excel
    Const MAX_ROW As Integer = 65500    'Maximum number of data rows for Excel
    Const MAX_COL As Short = 254        'Maximum number of tag columns for Excel

    Sub GetExcel()
        Try
            xlApp = GetObject(, "Excel.Application")
            xlBook = CType(xlApp.ActiveWorkbook, Excel.Workbook)
            xlSheet = CType(xlBook.Worksheets.Add, Excel.Worksheet)
        Catch
            xlApp = New Excel.Application()
            xlBook = CType(xlApp.Workbooks.Add, Excel.Workbook)
            xlSheet = CType(xlBook.Worksheets(1), Excel.Worksheet)
        End Try
    End Sub

    Function ProcessToExcel() As Short
        Dim r As Integer
        Dim iRow As Integer
        Dim iCol As Integer
        Dim AddTimestamp As Boolean = frmExport.chkTimestamp.Checked
        Dim AddInterval As Boolean = frmExport.chkInterval.Checked
        Dim AddOffset As Boolean = (frmExport.chkOffset.Enabled And frmExport.chkOffset.
    Checked)
        Dim ShowNaN As Boolean = frmExport.chkShowNaN.Checked

        'Make sure drReader object is reset so it can be assigned a new Type.
        drReader = Nothing

        'Show Wait mouse
        frmExport.Cursor = System.Windows.Forms.Cursors.WaitCursor
        frmExport.txtSummary.Cursor = System.Windows.Forms.Cursors.WaitCursor

        'Initialize Values
        bSaving = True
        bUserCancel = False
        NullCount = 0
        iPos = 0
        iCol = 1
        frmExport.ProgressBar1.Value = 0

        ' Check to make sure tag count is not exceeded.
        Dim TagCount As Short
        If frmExport.lvTags.Items.Count > MAX_COL Then
            TagCount = MAX_COL
            frmExport.txtSummary.Text += "Fields exceed Excel maximum. Truncating to " &
    MAX_COL & " tags..." & vbCrLf
            frmExport.Refresh()
        Else
            TagCount = frmExport.lvTags.Items.Count
        End If

        ' Check to make sure Row count is not exceeded.
        If frmExport.ProgressBar1.Maximum > MAX_ROW Then
            Dim sMessage As String = Format(frmExport.ProgressBar1.Maximum, "#,##0") & "
    rows exceed Excel maximum (" & Format(MAX_ROW, "#,##0") & ")."
            frmExport.txtSummary.Text += sMessage & vbCrLf
            frmExport.Refresh()
```

```
            Try
                DataArray(iPos, iCol - 1) = Format(drReader.GetValue(r), "#.000")
            Catch
                If ShowNaN Then
                    DataArray(iPos, iCol - 1) = "NaN"
                End If

                NullCount += 1
            End Try
        Next

        frmExport.ProgressBar1.Value = iPos
        iCol = 1
        iPos += 1

        System.Windows.Forms.Application.DoEvents()
        If bUserCancel Then
            frmExport.cmdExport.Text = "Export"
            'Clean-up
            DataArray = Nothing
            bSaving = False
            Return CANCELED
        End If
    Loop

    ' Open Excel and write Header
    frmExport.txtSummary.Text += "Launching Excel..." & vbCrLf
    frmExport.Refresh()

    Call GetExcel()

    'Write header
    iRow = 1
    iCol = 1

    If frmExport.chkHeader.Checked Then
        xlSheet.Cells(iRow, iCol) = frmExport.lvTests.SelectedItems(0).Text & ": " & ↙
frmExport.lvTests.SelectedItems(0).SubItems(1).Text
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "Oregon State University"
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "Start time = " & Format(dtStartDate, "MM/dd/yyyy↙
 HH:mm:ss")
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "End time = " & Format(dtEndDate, "MM/dd/yyyy HH:↙
mm:ss")
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "File created on " & Format(Now, "MM/dd/yyyy HH: ↙
mm:ss")
        iRow += 2
    End If

    'Write column fields
    If frmExport.chkTimestamp.Checked Then
        xlSheet.Range("A1:A" & (8 + frmExport.ProgressBar1.Maximum)).NumberFormat = "↙
MM/dd/yyyy HH:mm:ss"
        xlSheet.Cells(iRow, iCol) = "Timestamp"
        iCol += 1
    End If

    If frmExport.chkInterval.Checked Then
        xlSheet.Cells(iRow, iCol) = "Interval"
        iCol += 1
    End If

    xlSheet.Cells(iRow, iCol) = frmExport.lvTags.Items(0).Text
```

```
        bUserCancel = False
        NullCount = 0
        iPos = 0
        iCol = 1
        frmExport.ProgressBar1.Value = 0

        frmExport.txtSummary.Text += "Querying " & sServername & "..." & vbCrLf
        frmExport.Refresh()

        If Not ExecuteSP("jah_GetAllTags", Params, drReader) Then
            bSaving = False
            Return ABORTED
        End If

        Call BeginExport("Building array...")

        'Get Total Recordcount so we can correctly size the Array
        Dim RecordCount As Integer
        While drReader.Read()
            RecordCount += 1
        End While

        'Create 2-dimensional array to hold data values. Object data type assigned to
    allow both Date and numeric values to be saved.
        Dim DataArray(RecordCount, drReader.FieldCount) As Object
        frmExport.ProgressBar1.Maximum = RecordCount
        drReader = Nothing

        'Now, requery to actually get the data
        If Not ExecuteSP("jah_GetAllTags", Params, drReader) Then
            bSaving = False
            Return ABORTED
        End If

        Do While drReader.Read

            DataArray(iPos, 0) = drReader.GetValue(0)

            For r = 1 To drReader.FieldCount - 1
                DataArray(iPos, r) = drReader.GetValue(r)
            Next

            iPos += 1
            frmExport.ProgressBar1.Value = iPos

            System.Windows.Forms.Application.DoEvents()
            If bUserCancel Then
                frmExport.cmdExport.Text = "Export"
                bSaving = False
                Return CANCELED
            End If
        Loop

        ' Open Excel and write Header
        frmExport.txtSummary.Text += "Launching Excel..." & vbCrLf
        frmExport.Refresh()

        Call GetExcel()

        'Write header
        iRow = 1
        xlSheet.Cells(iRow, iCol) = "AP1000 Tag Details"
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "Oregon State University"
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "File created on " & Format(Now, "MM/dd/yyyy HH:mm:ss
```

```
        End While

        'Create 2-dimensional array to hold data values. Object data type assigned to allow both Date and numeric values to be saved.
        Dim DataArray(RecordCount, drReader.FieldCount) As Object
        frmExport.ProgressBar1.Maximum = RecordCount
        drReader = Nothing

        'Now, requery to actually get the data
        If Not ExecuteSP("jah_GetAllTests", Params, drReader) Then
            bSaving = False
            Return ABORTED
        End If

        Do While drReader.Read

            DataArray(iPos, 0) = drReader.GetValue(0)
            DataArray(iPos, 1) = drReader.GetValue(1)
            If Not IsDBNull(drReader.GetValue(2)) Then DataArray(iPos, 2) = Format(drReader.GetValue(2), "MM/dd/yyyy HH:mm:ss")
            If Not IsDBNull(drReader.GetValue(3)) Then DataArray(iPos, 3) = Format(drReader.GetValue(3), "MM/dd/yyyy HH:mm:ss")
            If Not IsDBNull(drReader.GetValue(4)) Then DataArray(iPos, 4) = Format(drReader.GetValue(4), "#,##0")

            iPos += 1
            frmExport.ProgressBar1.Value = iPos

            System.Windows.Forms.Application.DoEvents()
            If bUserCancel Then
                frmExport.cmdExport.Text = "Export"
                bSaving = False
                Return CANCELED
            End If
        Loop

        ' Open Excel and write Header
        frmExport.txtSummary.Text += "Launching Excel..." & vbCrLf
        frmExport.Refresh()

        Call GetExcel()

        'Write header
        iRow = 1
        iCol = 1

        xlSheet.Cells(iRow, iCol) = "AP1000 Test Schedule"
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "Oregon State University"
        iRow += 1
        xlSheet.Cells(iRow, iCol) = "File created on " & Format(Now, "MM/dd/yyyy HH:mm:ss")
        iRow += 2
        xlSheet.Cells(iRow, iCol) = "Test name"
        iCol += 1
        xlSheet.Cells(iRow, iCol) = "Description"
        iCol += 1
        xlSheet.Cells(iRow, iCol) = "Start date"
        iCol += 1
        xlSheet.Cells(iRow, iCol) = "End date"
        iCol += 1
        xlSheet.Cells(iRow, iCol) = "Duration (sec)"

        iRow += 1

        'Format date fields
```

```
Imports Microsoft.Win32 'For accessing the Registry

Public Class Export
    Inherits System.Windows.Forms.Form

 Windows Form Designer generated code

    Dim iTask As Short
    Dim TagsLoaded As Boolean
    Dim TestsLoaded As Boolean

    Const xTAGS As Short = 0
    Const xTESTS As Short = 1
    Const xPROCESS As Short = 2
    Const xSOE As Short = 3
    Const xDBSETUP As Short = 4

    '   The intent of playsound is to provide positive feedback when user changes
    parameters - not simply navigating windows.
    Declare Function PlaySound Lib "winmm.dll" Alias "PlaySoundA" (ByVal lpszName As
    String, ByVal hModule As Long, ByVal dwFlags As Long) As Long
    Const SN_NODEFAULT = &H2
    Const SND_FILENAME = &H20000
    Const SND_ASYNC = &H1

    Private Sub tabDBSetup_Paint(ByVal sender As Object, ByVal e As System.Windows.Forms.
    PaintEventArgs) Handles tabDBSetup.Paint
        Dim g As System.Drawing.Graphics
        Dim top As Integer = cmdDBSave.Top - 10
        Dim width As Integer = tabDBSetup.Width
        Dim myPenGry As New Pen(System.Drawing.SystemColors.InactiveCaption)

        g = tabDBSetup.CreateGraphics
        g.DrawLine(myPenGry, 208, top, width, top)
    End Sub

    Private Sub Form1_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
    MyBase.Load
        ' Define default button for form
        Me.AcceptButton = cmdFilter

        ' Show current version
        lblVersion.Text = "Version " & System.Diagnostics.FileVersionInfo.GetVersionInfo(
    System.Reflection.Assembly.GetExecutingAssembly.Location).FileMajorPart & "." &
    System.Diagnostics.FileVersionInfo.GetVersionInfo(System.Reflection.Assembly.
    GetExecutingAssembly.Location).FileMinorPart & "." & System.Diagnostics.
    FileVersionInfo.GetVersionInfo(System.Reflection.Assembly.GetExecutingAssembly.
    Location).FileBuildPart

        ' Make ColumnHeaders for Tag list
        With lvTags.Columns
            .Clear()
            .Add("Name", 100, HorizontalAlignment.Left)
            .Add("Units", 170, HorizontalAlignment.Left)
            ' extend description width to full length of listview
            .Add("Description", lvTags.Width - 195, HorizontalAlignment.Left)
        End With

        ' Make ColumnHeaders for Test list
        With lvTests.Columns
            .Clear()
            .Add("Name", 100, HorizontalAlignment.Left)
            ' extend description width to full length of listview
            .Add("Description", lvTests.Width - 365, HorizontalAlignment.Left)
            .Add("Start Time", 120, HorizontalAlignment.Left)
            .Add("End Time", 120, HorizontalAlignment.Left)
```

```
    End Sub

    Private Sub lblProcess_LinkClicked(ByVal sender As System.Object, ByVal e As System.
    Windows.Forms.LinkLabelLinkClickedEventArgs) Handles lblProcess.LinkClicked
        pbxProcess_Click(pbxProcess, New System.EventArgs())
    End Sub

    Private Sub lblSOE_LinkClicked(ByVal sender As System.Object, ByVal e As System.
    Windows.Forms.LinkLabelLinkClickedEventArgs) Handles lblSOE.LinkClicked
        pbxSOE_Click(pbxSOE, New System.EventArgs())
    End Sub

    Private Sub lblDBSetup_LinkClicked(ByVal sender As System.Object, ByVal e As System.
    Windows.Forms.LinkLabelLinkClickedEventArgs) Handles lblDBSetup.LinkClicked
        pbxDBSetup_Click(pbxDBSetup, New System.EventArgs())
    End Sub

    Private Sub Export_Paint(ByVal sender As Object, ByVal e As System.Windows.Forms.
    PaintEventArgs) Handles MyBase.Paint
        lvTags.Columns(2).Width = lvTags.Width - lvTags.Columns(0).Width - lvTags.Columns
    (1).Width - 25
        lvTests.Columns(1).Width = lvTests.Width - lvTests.Columns(0).Width - lvTests.
    Columns(2).Width - lvTests.Columns(3).Width - 25
    End Sub

    Private Sub pbxProcess_Click(ByVal sender As System.Object, ByVal e As System.
    EventArgs) Handles pbxProcess.Click
        iTask = xPROCESS
        Me.Text = "AP1000Export"

        If Not TestsLoaded Then
            If GetTests() Then
                TestsLoaded = True
            Else
                Exit Sub
            End If
        End If

        If Not TagsLoaded Then
            If GetTags(txtFilter.Text) Then
                TagsLoaded = True
                Call GetTagCount()
            Else
                Exit Sub
            End If
        End If

        'Show Select Tests tab
        Call CheckDates()
        Call ShowTab(3, False)
    End Sub

    Private Sub pbxDBSetup_Click(ByVal sender As System.Object, ByVal e As System.
    EventArgs) Handles pbxDBSetup.Click
        iTask = xDBSETUP
        ' Initialize DBsetup
        txtServer.Text = sServername
        txtODBCDriver.Text = sODBCDriver
        txtDataDir.Text = sDataDir
        txtURL.Text = sURL

        'Show Database Setup tab
        Call ShowTab(1, False)
    End Sub

    Private Sub pbxTagInfo_Click(ByVal sender As System.Object, ByVal e As System.
```

```
    Private Sub cmdFilter_Click(ByVal sender As Object, ByVal e As System.EventArgs)
    Handles cmdFilter.Click

        If Not cmdFilter.Enabled Then Exit Sub 'Make sure other steps cannot use Default
    button.

        If txtFilter.Text = "" Then
            Beep()
            Exit Sub 'Make sure the filter is not blank
        End If

        PlaySound(sClickPath, 0, SND_ASYNC)
        GetTags(txtFilter.Text)
        Call GetTagCount()
    End Sub

    Private Sub GetTagCount()
        Dim tagCount As Integer

        tagCount = lvTags.Items.Count
        ' Check for items in list
        If tagCount > 0 Then
            cmdNext_Tags.Enabled = True
            ToolBar1.Buttons(3).Enabled = True
        Else
            cmdNext_Tags.Enabled = False
            ToolBar1.Buttons(3).Enabled = False
        End If

        lblTagCount.Text = tagCount & " tags"

        'Disable Delete Toolbar button
        ToolBar1.Buttons(3).Enabled = False
    End Sub

    Private Sub ReloadTags()
        PlaySound(sClickPath, 0, SND_ASYNC)
        txtFilter.Text = "%"
        Call GetTags(txtFilter.Text)
        Call GetTagCount()
    End Sub

    Private Sub CheckDates()
        On Error GoTo Err_BadDate
        dtStartDate = CDate(lvTests.SelectedItems.Item(0).SubItems(2).Text)
        dtEndDate = CDate(lvTests.SelectedItems.Item(0).SubItems(3).Text)

        If DateDiff(DateInterval.Second, dtStartDate, dtEndDate) >= 0 Then
            cmdNext_Tests.Enabled = True
        Else
            cmdNext_Tests.Enabled = False
        End If

        Exit Sub

Err_BadDate:
        cmdNext_Tests.Enabled = False
    End Sub

    Private Sub ShowTab(ByVal tabIndex As Integer, ByVal bHistory As Boolean)
        ' First disable toolbar buttons.
        ToolBar1.Buttons(1).Enabled = False ' Home button
        ToolBar1.Buttons(3).Enabled = False ' Delete button
        ToolBar1.Buttons(4).Enabled = False ' Reload button
```

```
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "Export_Maximized", Me.WindowState = FormWindowState.Maximized)
    If Me.WindowState = FormWindowState.Maximized Then Exit Sub

    '   Write General settings to the registry
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "Export_Left", Me.Left)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "Export_Top", Me.Top)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "Export_Width", Me.Width)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "Export_Height", Me.Height)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "chkAutoClose", chkAutoClose.CheckState)
End Sub

Private Sub lvTests_SelectedIndexChanged(ByVal sender As Object, ByVal e As System.
EventArgs) Handles lvTests.SelectedIndexChanged
    Call CheckDates()
End Sub

Private Sub lvTests_KeyUp(ByVal sender As System.Object, ByVal e As System.Windows.
Forms.KeyEventArgs) Handles lvTests.KeyUp
    Call CheckDates()
End Sub

Private Sub SetOffset()
    If chkInterval.Checked Then
        If iInterval > 120 Then
            chkOffset.Enabled = False
        Else
            chkOffset.Enabled = True
        End If
    Else
        chkOffset.Enabled = False
    End If
End Sub

Private Sub cboInterval_SelectedValueChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles cboInterval.SelectedValueChanged
    Select Case cboInterval.Text
        Case "1 second"
            iInterval = 1
        Case "2 seconds"
            iInterval = 2
        Case "5 seconds"
            iInterval = 5
        Case "10 seconds"
            iInterval = 10
        Case "30 seconds"
            iInterval = 30
        Case "1 minute"
            iInterval = 60
        Case "2 minutes"
            iInterval = 120
        Case "5 minutes"
            iInterval = 300
    End Select

    Call SetOffset()
End Sub

Private Sub chkTimestamp_Click(ByVal sender As System.Object, ByVal e As System.
EventArgs) Handles chkTimestamp.Click, chkInterval.Click, chkOffset.Click, chkHeader.
```

```
                Case "tabRetrieval"
                    ' Calculate start offset
                    If chkOffset.Enabled And chkOffset.Checked Then
                        StartDate = DateAdd(DateInterval.Second, -120, dtStartDate)
                    Else
                        StartDate = dtStartDate
                    End If

                    EndDate = dtEndDate

                    ' Get maximum Progressbar value by calculating ceiling value of
estimated rows. Add 1 to always round up (ceiling).
                    ProgressBar1.Maximum = DateDiff(DateInterval.Second, StartDate,
EndDate) / iInterval + 1

                    Call BuildSummary(xPROCESS)
                    ' Show Export tab
                    Call ShowTab(5, False)

                Case "tabExport"

            End Select
        Case 3                      ' Export SOE
    End Select
End Sub

Private Sub cmdDBSave_Click(ByVal sender As System.Object, ByVal e As System.
EventArgs) Handles cmdDBSave.Click
    PlaySound(sClickPath, 0, SND_ASYNC)
    Call SaveDBSettings()
    Call ShowTab(0, False)
End Sub

Private Sub cmdDBCancel_Click(ByVal sender As System.Object, ByVal e As System.
EventArgs) Handles cmdDBCancel.Click
    Call ShowTab(0, False)
End Sub

Private Sub cmdQuit_Click(ByVal sender As System.Object, ByVal e As System.EventArgs)
 Handles cmdQuit.Click
    End
End Sub

Private Sub cmdNext_Tags_Click(ByVal sender As System.Object, ByVal e As System.
EventArgs) Handles cmdNext_Tags.Click, cmdNext_Tests.Click, cmdNext_Retrieval.Click
    Call GetNext()
End Sub

Private Sub optFile_CheckedChanged(ByVal sender As System.Object, ByVal e As System.
EventArgs) Handles optFile.CheckedChanged, optExcel.CheckedChanged, optNRC.
CheckedChanged
    If sender.Checked Then
        If TabControl1.SelectedTab.Name = "tabExport" Then
            PlaySound(sClickPath, 0, SND_ASYNC)
        End If
    End If
End Sub

Private Sub BuildSummary(ByVal iTask As Short)
    Select Case iTask
        Case xTAGS
            txtSummary.Text = vbCrLf & "----- Summary" & vbCrLf & vbCrLf
            txtSummary.Text += "Task: Export Tag details" & vbCrLf & vbCrLf & vbCrLf

        Case xTESTS
            txtSummary.Text = vbCrLf & "----- Summary" & vbCrLf & vbCrLf
```

```
file.
                    Dim myProcess As New Process()
                    txtSummary.Text += "Running Databank binary conversion (
MakeBinary.bat)..." & vbCrLf
                    myProcess.StartInfo.FileName = Replace(System.Reflection.Assembly
.GetExecutingAssembly.Location, "AP1000Export.exe", "MakeBinary.bat")
                    myProcess.StartInfo.Arguments = """" & Replace(SaveFileDialog1.
FileName, ".bin", "") & """"
                    myProcess.StartInfo.WindowStyle = ProcessWindowStyle.Normal
                    myProcess.Start()
                End If
            End If
        End If

        Select Case ExportResult
            Case CANCELED
                txtSummary.Text += vbCrLf & "Canceled by user at " & Now & vbCrLf &
vbCrLf

            Case COMPLETED
                txtSummary.Text += vbCrLf & "Completed at " & Now & vbCrLf
                txtSummary.Text += "Total rows retrieved = " & Format(iPos, "#,##0")
& " rows" & vbCrLf
                txtSummary.Text += "There were " & Format(NullCount, "#,##0") & "
Nulls in the data." & vbCrLf & vbCrLf

                Call SaveSettings()

                'Automatically close if AutoClose checkbox selected.
                If chkAutoClose.Checked Then End

            Case ABORTED
                txtSummary.Text += "Aborted at " & Now & vbCrLf
                txtSummary.Text += ErrMsg & vbCrLf & vbCrLf
        End Select

        ' Show normal mouse
        frmExport.Cursor = System.Windows.Forms.Cursors.Default
        txtSummary.Cursor = System.Windows.Forms.Cursors.Default
        cmdExport.Text = "Export"

    Else ' Cancel button pressed
        bUserCancel = True
    End If
End Sub

Private Sub SaveSettings()
    '   Write User Selected settings to the registry
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "txtFilter", txtFilter.Text)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "cboInterval", cboInterval.Text)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "chkHeader", chkHeader.CheckState)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "chkTimestamp", chkTimestamp.CheckState)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "chkInterval", chkInterval.CheckState)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "chkOffset", chkOffset.CheckState)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "chkShowNaN", chkShowNaN.CheckState)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "optNRCUnits", optNRCUnits.Checked)
    SaveSetting(System.Reflection.Assembly.GetExecutingAssembly.GetName.Name, "
Settings", "optFile", optFile.Checked)
```

```
        If sender.Checked Then
            If TabControl1.SelectedTab.Name = "tabRetrieval" Then
                PlaySound(sClickPath, 0, SND_ASYNC)
            End If
        End If
    End Sub


    Private Sub optSimpleUnits_CheckedChanged(ByVal sender As Object, ByVal e As System. ↙
    EventArgs) Handles optSimpleUnits.CheckedChanged
        If sender.Checked Then
            If TabControl1.SelectedTab.Name = "tabRetrieval" Then
                PlaySound(sClickPath, 0, SND_ASYNC)
            End If
        End If

    End Sub
End Class
```

MakeBinary.bat

```
@echo off
Title NRC Databank binary

rem Syntax is MakeBinary.bat <filename>
rem Where <filename> indicates desired output filename and path without an
extension.
rem Example: MakeBinary.bat "C:\OSU-AP1000-01"
rem Output: two files -> OSU-AP1000-01.bin and OSU-AP1000-01.rep, where *.bin is the
rem data file and *.rep is the report file.
rem File locations may need modification if PERL scripts are changed.
rem Path for source file must be D:\DataBank\Raw\Test001.txt.

set oFile=%1
set oTest001="D:\DataBank\Testdata\Test001\Test001.bin"
set oTest001rep="D:\DataBank\Testdata\Test001\Test001.rep"

if %oFile% == "" goto :EOF

echo ****************************
echo **   NRC Databank Binary   **
echo ****************************
echo J. Hopson
echo Copyright 2003 Oregon State University
echo.
echo This program converts a process data file into NRC
echo Databank binary format.
echo.

d:
cd d:\Databank\data
rmdir Test001 /s /q
mkdir Test001

cd d:\Databank\Channel
rmdir Test001 /s /q

cd d:\Databank\Testdata
rmdir Test001 /s /q

cd d:\Databank\
rmdir TWX /s /q
mkdir TWX

cd d:\Databank\Data\Test001
perl ..\..\Scripts\step-3.plx ..\..\Raw\Test001.txt
del Interval

cd d:\Databank\Scripts
perl step-4.plx Test001

cd d:\Databank\Channel\Test001
perl ..\..\Scripts\step-5.plx Test001

cd d:\Databank\Scripts
perl step-6.plx Test001

if not exist %oTest001% goto DONE
echo.
copy %oTest001% %oFile%.bin
copy %oTest001rep% %oFile%.rep
echo.
echo ****************************
echo **        COMPLETE        **
```

```
#
# This program converts test data into the TWX format
#
# Written by:
# Robert Beaton
# ISL, Inc.
# April, 2003
#
# NOTE: This file must be modified when you change Units in the AP1000 Database!!
# J. Hopson May 14, 2003

$seq = 0;
$test = $ARGV[0];

# Define and create output directory

$outdir = "/D/DataBank/Channel/$test";
mkdir("$outdir",0755) || die "Cannot create $outdir directory\n";

# Define data source directory
$testdir = "/D/DataBank/Data/$test";

opendir(DIR, "$testdir");
   @listdir = sort grep(!/^\./, readdir(DIR));
closedir(DIR);

# Repeat process for each file in data directory

foreach (@listdir) {
   $seq++;
   $timeseq = (7000 + $seq);
   $channel = $_;
   $infile = "/D/DataBank/Data/$test/$channel";

   open(IF,"$infile") || die "Cannot open INFILE $infile\n";
      @data = (<IF>);
   close IF;

# Determine the number of samples

   $sample = grep(!/\@/, @data);
   $block = ($sample * 8);

# Determine the Units Code

   @x = grep(/yaxis/, @data);
   $yaxis = $x[0];
   print "Channel: $channel, YAXIS: $yaxis\n";

# AP1000 Database units
        if ($yaxis =~ /Differential Pressure \(in h2o\)/)      {$eucode = 519;}
        elsif ($yaxis =~ /Differential Pressure \(psid\)/)     {$eucode = 16;}
        elsif ($yaxis =~ /Fluid Temperature \(F\)/)            {$eucode = 2;}
        elsif ($yaxis =~ /Internal Rod Temperature \(F\)/)     {$eucode = 54;}
        elsif ($yaxis =~ /Mass \(lbm\)/)                       {$eucode = 46;}
        elsif ($yaxis =~ /Power \(kW\)/)                       {$eucode = 18;}
        elsif ($yaxis =~ /Pressure \(psia\)/)                  {$eucode = 15;}
        elsif ($yaxis =~ /Pressure \(psig\)/)                  {$eucode = 3;}
        elsif ($yaxis =~ /Steam Flow Rate \(cfm\)/)            {$eucode = 521;}
        elsif ($yaxis =~ /Wall Temperature \(F\)/)             {$eucode = 522;}
        elsif ($yaxis =~ /Water Level \(in\)/)                 {$eucode = 520;}
        elsif ($yaxis =~ /Voltage \(V\)/)                      {$eucode = 234;}
        elsif ($yaxis =~ /Volumetric Flow Rate \(gpm\)/)       {$eucode = 395;}
```

OREGON STATE UNIVERSITY

DEPARTMENT OF NUCLEAR ENGINEERING

ADVANCED THERMAL HYDRAULIC RESEARCH LABORATORY

OSU-DAS-001

DATA ACQUISITION SYSTEM FUNCTIONAL SPECIFICATION

Revision 1

Submitted by: 05/08/03

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Data Acquisition System Functional Specification

OREGON STATE UNIVERSITY

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Revision 1

1.0 INTRODUCTION

1.1 Purpose

This document defines the general and functional requirements that will be the basis for design, development, testing, and accepting of the new Data Acquisition System (DAS) installed in the Advanced Thermal Hydraulics Research Lab (ATHRL). A DAS Requirement Matrix, located at the end of this document, provides a list of Requirements and their priorities relative to the AP1000 project.

1.2 Executive Summary

The intent of this Functional Specification is to define requirements to ensure the integrity and reliability of experimental data associated with the AP1000 project. Delivery of such proprietary information is made possible by a DAS, which includes all the equipment necessary to transmit, receive, process, and record the voltage and current signals from the individual sensing instruments. The DAS system includes three primary components:

- Data Acquisition (DAQ) - receives signals from individual instruments, scales them to appropriate Engineering Units, and makes them available on the computer network.
- Historian - stores values from the acquisition system for subsequent retrieval and analysis.
- Human-Machine-Interface (HMI) - primarily used for supervisory control, monitoring, and the safe operation of the facility.

According to verification and validation policies as defined in the ATHRL Quality Plan, the acquisition system and historian shall require formal confirmatory testing prior to executing the AP1000 project. This document, therefore, outlines the requirements from which the Data Acquisition and Historian verification and validation procedures shall be developed. Because the HMI does not directly affect the data being recorded, HMI verification and validation procedure shall be conducted internally and not included in the Final Report.

1.3 Scope

This document serves as minimum requirements for specifying, procuring, and configuring hardware and software associated with the DAS. Such systems are generally used to acquire, monitor, and record process data. The intent is to ensure that the installed system is capable of recording and retrieving process data in a consistent and accurate manor.

1.4 How to Read this Document

Each functional requirement includes a priority code following the description as shown below:

Index: Title	1

Priority codes are used to schedule the development effort and from which verification and validation procedures will be defined. Refer to the following definitions for priorities included in this document:

Test Priorities

1 - Critical requirement; cannot begin testing without this function.

2 - Significant requirement; may be implemented between tests until satisfied.

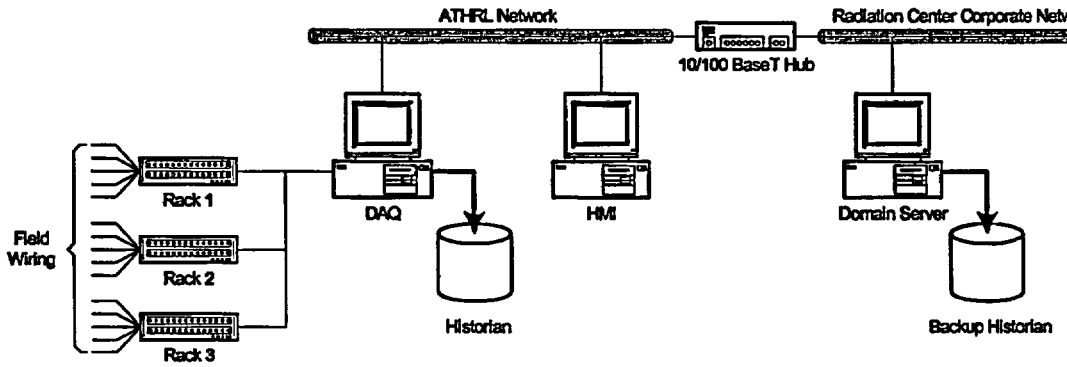
3 - Nice-to-have requirement; may be deferred but should be implemented for future projects.

2.0 FUNCTIONAL REQUIREMENTS

2.1 Architecture

The general architecture is shown below. Field device wiring shall be terminated on I/O racks to condition the voltage and current signals and provide real-time data to channels defined in the DAQ workstation. Process dynamics and operation shall be monitored at a HMI workstation and archived to a Historian for subsequent retrieval and analysis. At the end of each test, procedures shall be defined to copy data to a backup historian.

FIGURE 1. Data Acquisition System



2.2 Data Acquisition

The DAQ shall provide capability to define the configuration of input channels and associated sensor input parameters for sensor type and quantity as specified herein.

2.2.1 System Capacity

The system shall be capable of scanning, processing, and storing input data from all channels under conditions specified. The ATHRL facility has approximately 622 analog sensor inputs.

DAQ: System Capacity	1

2.2.2 Input Channel Configuration

Process input channels shall be configurable for the following: 4-20 mA, 1-5 VDC and 0-10 VDC ranges. The DAQ shall provide for the transfer of channel configuration data to the data acquisition equipment. Information for every channel to be scanned shall include at a minimum:

- Channel name and description
- Channel physical address (I/O point)
- Engineering Units, Lower Range Value, Upper Range Value and I/O mapping curve information.
- Frequency of scan

Thermocouple input channels shall be compatible with any combination of J, K, and T type thermocouples. Only differential voltage channels shall be used for thermocouple inputs.

DAQ: Input Channel Configuration	1

2.2.3 Field I/O Mapping

Data acquired for process monitoring and storage shall be converted to English Engineering Units and appropriately scaled for the physical attribute being measured.

DAQ: Field I/O Mapping	1

2.2.4 Temperature Compensation and Linearization

The system shall provide automatic temperature compensation for connected thermocouples. All thermocouple inputs shall be linearized prior to scanning and storage.

DAQ: Temperature Compensation and Linearization	1

2.2.5 I/O Communications

The system shall provide appropriate communications to transfer information from the DAQ to the Historian and HMI. At a minimum, the DAQ shall support TCP/IP Ethernet and simultaneous OPC client and server protocols.

DAQ: I/O Communication	2

2.2.6 Real-Time Clock

Data shall be time-stamped at the time the data is received by the acquisition hardware using the DAQ workstation clock. The clock shall not be affected by system utilization and shall not be adjusted during a test operation. The clock shall not require re-initialization following equipment power loss.

DAQ: Real-Time Clock	1

2.2.7 Backup Power Supply

The power supply shall provide un-interruptible service for a minimum of 20 minutes to any equipment necessary to ensure that test data is completely transferred to permanent storage.

DAQ: Backup Power Supply	1

2.3 Historian

The system shall provide a historical database for long-term storage of process data. The historian shall provide for the storage of real-time and historical data for each channel.

2.3.1 Channel Configuration

The data historian shall include a stand-alone database editor to modify the parameters of any channel without using the DAQ database editor. This editor shall provide means to export and import configuration settings in standard CSV or tab-delimited format.

Historian: Channel Configuration	1

2.3.2 Data Acquisition and Storage

The data historian database shall acquire and store process data at full resolution up to a maximum of one hertz. It shall be possible to configure analog data storage rate by independent cyclic and delta conditions. Cyclic storage, as defined here, provides data storage at a pre-determined interval. For example, a cyclic storage rate of one hertz. Delta storage, as defined here, provides data storage based on the value deviation as a function of full span. For example, a delta storage condition when the current value exceeds 0.01% full-scale of the previously stored value.

The data storage system shall be sized to support the anticipated data load for at least ten years.

Historian: Data Acquisition and Storage	1

2.3.3 Data Retrieval

It shall be possible to retrieve data at a resolution different than how the channel was stored. There shall exist methods to query and retrieve data cyclically, with millisecond resolution, no matter the storage mode. It shall be possible to query and retrieve data in delta, with user defined deadband criteria and millisecond resolution, no matter the storage mode.

Historian: Data Retrieval	2

2.3.4 Zero Administration Management

The data historian shall not require specialized tools for disk storage management. It shall be possible to archive and retrieve historical data files using standard Windows® copy techniques. It shall be possible to retrieve select portions of archived data without retrieving all archived data. Retrieval of the archive data shall automatically place this data on-line and available for retrieval by the data historian.

Historian: Zero Administration Management	2

2.3.5 Integration with Other Databases

The method for retrieving data shall include the ANSI-92 Structured Query Language (SQL) syntax to simplify the transfer of historical process data with other databases. The historian database shall include an OLEDB Provider or ODBC driver so that any other SQL client can access the real-time or historical process data from the Historian.

Historian: Integration with Other Databases	3

2.3.6 Data Export

The Final Report of AP1000 Research shall include proprietary data from the Historian. Data shall be exported using standard database query tools, including a utility to format the data in ANSI standard CSV/tab delimited files. Such format shall enable the sponsor to view data in commercially available spreadsheet programs such as Microsoft Excel™. It shall not be required to write any macros to retrieve the data. The format for data export shall be similar to the following:

OSU-AP1000-03: Double-Ended DVI with 3 of 4 ADS 4
Oregon State University
Start time = 05/01/2003 15:07:02
End time = 05/01/2003 17:27:00
File created on 05/01/2003 17:30:37

Timestamp	Interval sec	DP-111 in H2O	DP-114 in H2O	DP-121 in H2O	DP-122 in H2O	DP-123 in H2O	DP-124 in H2O	DP-125 in H2O	DP-126 in H2O
5/1/2003 15:07:33	0	9.105	5.861	-9.868	-6.842	-12.096	-11.823	31.531	31.529
5/1/2003 15:07:34	1	9.054	4.942	-10.422	-7.677	-12.212	-11.854	31.531	31.529
5/1/2003 15:07:35	2	9.394	5.861	-9.733	-7.281	-12.791	-12.042	31.529	31.527
5/1/2003 15:07:36	3	9.068	4.655	-10.153	-7.281	-12.384	-12.22	31.529	31.524
5/1/2003 15:07:37	4	7.774	5.172	-10.83	-7.069	-12.933	-11.788	31.531	31.527
5/1/2003 15:07:38	5	8.035	5.402	-10.826	-7.974	-12.945	-13.086	31.534	31.529
5/1/2003 15:07:39	6	7.696	5.172	-10.999	-8.297	-12.388	-12.123	31.531	31.524

Historian: Data Export	1

2.3.7 Data Backup

The data storage system shall provide the capability to archive and merge records with a secured long-term process repository. A utility shall be provided to automatically execute database backup and to merge records.

Historian: Data Backup	1

2.4 Human-Machine Interface

The Data acquisition and storage system shall be fully integrated with the human-machine interface (HMI) package.

2.4.1 Display Navigation

Operators shall interface to all process and related activities through easily recognized icons, pull down or full screen menus. The system runtime software shall support operator access to multiple displays at one time, including split screens where the operator may view more than one process area at a time. In addition, the system shall support unlimited use of pop-up displays for additional help or diagnostic information. The operator shall be able to have access to context sensitive on-line help or instructions from any display at any time during operation of the system with a single keystroke or mouse click.

The operator shall be able to easily identify which objects are selectable from any display by simply dragging the pointing device over the object. Typical objects include process device symbols (pumps, motors, etc.) controller faceplates, buttons or switches or sliders.

HMI: Display Navigation	2

2.4.2 Full Function Operator Workstation

The plant operator shall be able to execute all monitoring and supervisory control functions from this workstation. Typical operator commands include modifying setpoints for control loops, alarm acknowledgment and setpoint adjustment, auto/manual switching and on/off control of field devices, and taking points or devices on/off scan.

HMI: Full Function Operator Workstation	2

2.4.3 General Trending Requirements

The HMI shall include trending capabilities to view any or all of the channels in either a trend chart or tabular format. It shall be possible for the user to switch from real time to historical viewing mode. The user shall be able to toggle from viewing trends either in the superimposed or the stacked mode. In the superimposed mode, all trends overlap and are in a single scale range based on the largest vertical scale range in the group. In the stacked mode, each trend has its own vertical scale range. Trend plots shall automatically be scaled based on the widest vertical range of the channel or optimized based on the maximum and minimum range within the selected time period.

HMI: General Trending Requirements	2

2.4.4 Real-Time Trending

The user shall be able to trend up to 16 different channels in real time including analog, discrete, string or event channels within the same trend. The user shall pick channels from a browser. The time span and vertical range of the trend shall be user configurable at run time. Standard time spans shall be configured for the last 5, 10, 30, or 60 minutes or the last 2, 4, or 8 hours. The user shall be able to adjust the range of the channels in run time.

HMI: Real-Time Trending	2

2.4.5 Historical Trending

The user shall be able to plot historical data for any channels or groups of channels in the Historian based on any user-selected start and stop time. Two hairline cursors may be turned on and dragged across the trend area to provide the user with the exact value for each trended channels at the point of intersection. The time span between the cursors shall also be displayed. It shall be possible to overlay data from different start/end times to compare the performance of equipment/process for different time intervals. It shall be possible to overlay 'live' trends onto history traces to compare performance The trend tool shall display statistical data for each trended analog channels within the time period selected. Statistical values shall include the minimum, maximum, average, and standard deviation. Icons or menu pull down commands shall be available for analyzing the data such as horizontal, vertical or rubber-band zooming, pan left or right and zoom between the hairline cursors. Printing of the trends shall be supported.

HMI: Historical Trending	2

2.4.6 Alarm Configuration

An alarm function shall be supported to alert the plant operator when a signal level is outside a predetermined range. The system shall allow the definition of alarm levels for each channel. Alarm limits shall be provided as a channel configuration parameter prior

to testing and shall not be re-defined while a test is being performed. The alarm system shall support multiple simultaneous alarm client displays. In the event of an alarm storm (hundreds or thousands of alarms detected within one second), the Alarm System shall report - and the client shall be capable of - displaying up to 2000 new alarms within ten seconds of the detection.

The operator shall be able to view current and historical alarm information from a full screen alarm-summary display or on a small scrolling region on the bottom of any display. The alarm information shall be displayed in chronological order with the most recent alarm at the top. The information capable of being displayed for each alarm shall include the time and date, description, channel, alarm state, alarm type (lo, lo-lo, hi, hi-hi, rate-of-change, etc.), value, acknowledging operator and priority level.

HMI: Alarm Configuration	2

2.4.7 Alarm Displays

Alarms shall be displayed by configuring a user-defined alarm summary object, which may be placed by itself or along with other objects in a window. The display shall be able to display currently active alarms (alarm summary) or alarms that have since been acknowledged and cleared (alarm history). Alarms shall be color coded according to the state and priority of the alarm including an acknowledged alarm, unacknowledged alarm, and an alarm that has returned-to-normal. The alarm display object shall also support event displays when operators change setpoints and initiate/terminate a test.

HMI: Alarm Displays	2

2.4.8 Alarm Filtering and Suppression

It shall be possible for the operator to filter the alarm display based on priority level, groups or process area. The name of the operator and the node acknowledging the alarm shall be capable of being displayed in the Alarm Summary. The operator shall also be able to suppress alarms on the local display.

HMI: Alarm Filtering and Suppression	3

2.4.9 Alarm Announcement

It shall be possible to configure the system such that the operator is notified of an alarm no matter which display the operator is currently viewing. Notification shall include the option of a pop-up alarm display window, a flashing process symbol such as a process vessel, an alarm text message that is available on each display, or a dedicated alarm display window anywhere on the screen.

The system shall provide a method of notifying the user when a new alarm has occurred. The alarm display object shall automatically scroll to a new alarm when the user has scrolled down the alarm list from the top.

HMI: Alarm Announcement	2

2.4.10 Alarm Acknowledgment

The operator shall be able to select and acknowledge alarms individually, by group or process area. The operator shall also be able to acknowledge only those alarms visible in the display, only those selected, only the most recent alarm or all alarms in the system.

HMI: Alarm Acknowledgement	2

2.4.11 Alarm Printing

Alarms may be printed to a locally connected or network printer. The alarms printed shall be based on the currently displayed alarms, or from a separate query to the database.

HMI: Alarm Printing	2

2.4.12 Event Configuration

An event system shall be incorporated to archive changes that do not necessarily require immediate attention and for post-analysis such as Sequence-of-Events reporting.

All operator actions shall be logged to an event logger. The event logger shall keep track of each new test run, setpoint change, or device control. Each event log shall record the date, time, operator logged in and the type of action taken (setpoint change, state change, etc.). Any configured integer, real, discrete, or string channel may also be configured as an event. The point shall be logged as an event any time its value changes.

HMI: Event Configuration	2

2.4.13 Alarm/Event Storage

Alarms and events shall be logged to a database that is seamlessly integrated with the Data Historian. Alarm details shall include alarm instantiation, return-to-normal, acknowledgment, date and time of the event, Group, Channel, Type (LoLo, Lo, Hi, HiHi, ROC, Deviation, disc, etc.), operator name when acknowledged and Priority.

HMI: Alarm/Event Storage	2

2.5 Human-Machine Interface Development

The DAS system shall include an object-oriented color graphics display generator with full animation capabilities to provide users with a realistic visualization of the ATHRL process. The display editor shall include the following tools for display drawing, linking and animation.

HMI: Human-Machine Interface Development	2

2.5.1 General Requirements

The graphics editor shall include a set of basic drawing tools to create complex objects. Any of these objects can be assigned various attributes such as line color, fill color, size, and orientation and can be made static or dynamic. Text objects shall be scaleable and use true fonts in bold italic or underline. All objects shall be scaleable and moved in any direction one pixel at a time or dragged with a mouse.

The graphics editor shall support standard object manipulation functions such as cut, copy, paste and delete. Alignment tools shall be included to simplify proper placement and arrangement of objects. Align commands shall be included to align objects based on justification to the left, right, center, top or bottom. Object commands shall also be included to space them vertically, horizontally, move to back, move to front, rotate or group and ungroup.

Development: General Requirements	2

2.5.2 Object Requirements

The graphics editor shall include a broad library of complex objects and process symbols such as meters, pushbuttons, sliders, gauges, pumps, motors, tanks, valves, trends, alarms, controller faceplates and bitmaps. All complex objects shall be scaleable to any size and may include animation links to provide dynamic response based on real time data or user action.

Object Animation - Objects shall be animated based on the following attributes:

- Color change of the object. The color palette shall be based on 16.7 million colors. System must also support the user choosing transparent colors for all graphical objects and backgrounds.
- Percentage of fill for objects up, down, left or right direction based on a tag name.
- Blinking of the object based upon any alarm or event or upon a designated group of alarms. The blink shall be adjustable to slow, medium or fast.

- Each object shall have a visibility attribute option allowing for visibility of the object based upon the status of a discrete point, alarm, or operator security level.
- The system shall support animation of objects via re-sizing, moving, and/or rotating based upon a change in the associated channel.
- Objects shall be animated based upon any user-defined criteria made up of current values and mathematical expressions.

Development: Object Requirements	2

2.5.3 Display Configuration

The Graphics Editor shall allow layering of objects to activate specific objects based upon conditions in the process. Graphics development tools shall allow object placement via a "snap-to-grid" feature with configurable grid spacing. Graphics development tools shall support an "undo/redo" feature with a configurable number of levels and command displays.

The Graphics Editor shall allow the user to import drawings and images in BMP, JPEG, PCX, and TGA file format. The graphics development environment shall support the copy of single or multiple animated graphic objects and symbols with just two keystrokes, and immediate substitution of channels for the duplicated object shall be possible without leaving the graphics editor.

The graphics development environment shall support the copy of single or multiple animated graphic objects and symbols from one window or display to another retaining all of the animation characteristics, links and attributes. In addition it shall be possible to import windows from another application.

User shall have the capability to search for channels while building a display and then get the exact detail of the item (alarm setpoints, I/O address, and all other channel details) while building a display without exiting the graphics editor.

The user shall be able to define graphic screens while the system is monitoring the process (runtime mode). It shall be possible to perform a functional test of any graphic display by switching to the runtime mode at any time.

Development: Display Configuration	2

2.6 Security

The DAS system shall provide the capability to prevent unauthorized access or modification of any function.

2.6.1 Runtime Security

The runtime software shall include a security system integrated with Windows security to enable various operator tasks based on the user level and password. Access to all displays and to all command functions shall be based on the operator's security level to protect against unauthorized use. After initial creation, only an assigned user with proper authorization or the system administrator shall modify the password.

Visibility and operation of command buttons, setpoints, symbols, or entire displays shall be enabled or disabled based upon the operator's security level. The security level shall be established during the operator log-on procedure.

The security system shall be capable of disabling access to all Microsoft Windows controls (file menu, close, minimize, etc.) and keyboard commands (Ctrl-ESC, Alt-Tab, and Ctrl-Alt-Del).

Security: Runtime Security	1

2.6.2 Security During a Test

Channel configuration and changes that may affect the integrity of process data shall be disabled when testing begins.

Security: Security During a Test	1

3.0 DAS Requirements Matrix

Test Priorities:

1 - Critical requirement; cannot begin testing without this function.

2 - Significant requirement; may be implemented between tests until satisfied.

3 - Nice to Have requirement; may be deferred but should be implemented for future projects.

TABLE 1. DAS Requirement Matrix Ranking Table

Functional Requirement	Priority	Page
DAQ: System Capacity	1	3
DAQ: Input Channel Configuration	1	4
DAQ: Field I/O Mapping	1	4
DAQ: Temperature Compensation and Linearization	1	4
DAQ: Real-time Clock	1	4
DAQ: Backup Power Supply	1	5
HISTORIAN: Channel Configuration	1	5
HISTORIAN: Data Acquisition and Storage	1	5
HISTORIAN: Data Export	1	6
HISTORIAN: Data Backup	1	7
SECURITY: Runtime Security	1	12
SECURITY: Security During a Test	1	13
DAQ: I/O Communication	2	4
HISTORIAN: Data Retrieval	2	5
HISTORIAN: Zero Administration Management	2	6
HMI: Display Navigation	2	7
HMI: Full Function Operator Workstation	2	7
HMI: General Trending Requirements	2	8
HMI: Real-Time Reading	2	8
HMI: Historical Trending	2	8
HMI: Alarm Configuration	2	9
HMI: Alarm Displays	2	9
HMI: Alarm Announcement	2	9
HMI: Alarm Acknowledgment	2	10
HMI: Alarm Printing	2	10
HMI: Event Configuration	2	10
HMI: Alarm/Event Storage	2	10
DEVELOPMENT: General Requirements	2	11
DEVELOPMENT: Object Requirements	2	11
DEVELOPMENT: Display Configuration	2	12
HISTORIAN: Integration with Other Databases	3	6
HMI: Alarm Filtering and Suppression	3	9

4.0 Related Documents

Documents related to this Functional Specification are listed below:

- Hopson, J., "*General Purpose for Software Verification and Validation*," December 18, 2002.
- Bobick, N., "*DAS Functional Requirements Specification*," November 5, 1994