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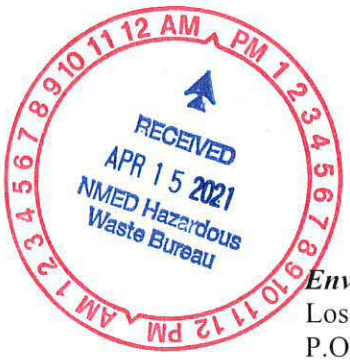

N3B-Los Alamos
1200 Trinity Drive, Suite 150
Los Alamos, New Mexico 87544
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Environmental Management
Los Alamos Field Office
P.O. Box 1663, MS M984
Los Alamos, New Mexico 87545
(505) 257-7950/FAX (505) 606-2132

Date: April 15, 2021
Refer To: N3B-2021-0063

Mr. Kevin Pierard, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6313

Subject: Class 1 Permit Modification Request Requiring Prior Approval for Treatment in Containers at TA-54-0412 for the Los Alamos National Laboratory Hazardous Waste Facility Permit, EPA ID No. NM0890010515

Dear Mr. Pierard:

Enclosed is a Class 1 permit modification request requiring prior approval from the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) to modify the Los Alamos National Laboratory (LANL) Hazardous Waste Facility Permit (the Permit) issued to the U.S. Department of Energy (DOE); Triad National Security, LLC; and Newport News Nuclear BWXT-Los Alamos, LLC (N3B) (the Permittees). The Permittees request the addition of a treatment process at a permitted unit, and the enclosed permit modification provides proposed revisions to text and figures in the Permit Part 7, as well as to Attachments A, C, E, G.6, J, and N.

This permit modification request has been prepared in accordance with 40 Code of Federal Regulations (CFR) Section 270.42 "Permit Modification at the Request of the Permittee," paragraph (a). This modification request includes the addition of treatment of hazardous waste by stabilization (including absorption) and neutralization at one permitted storage unit. Item F.1.c in Appendix I, "Modification Table," of 40 CFR 270.2 states that the Permittees may submit a proposed Class 1 permit modification of a hazardous waste facility permit to add a treatment process necessary to treat hazardous wastes that are restricted from land disposal to meet some or all applicable treatment standards. It is necessary for the Permittees to treat legacy waste located at Technical Area 54 (TA-54), Area G, to remove the Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics of ignitability, corrosivity, and reactivity. The treatment of the waste is intended to remove U.S. Environmental Protection Agency (EPA) Hazardous Waste Numbers D001, D002, and D003 (ignitability, corrosivity, and reactivity, respectively).

The Permittees request adding a treatment process to TA-54, Area G, Pad 1, Building 412 (TA-54-0412). Per 40 CFR 270.42, Appendix I, Item F.1.c., the Permittees may submit a proposed Class 1 (i.e., requires prior approval by NMED) permit modification to add a treatment process

necessary to treat hazardous wastes that are restricted from land disposal to meet some or all applicable treatment standards.

This modification request includes adding treatment to stabilize containerized legacy mixed waste using neutralization and absorption methods at the TA-54-0412 permitted unit. This treatment process can be incorporated into the permit using a Class 1 modification request because the only changes to the permitted storage unit are related to the addition of the treatment process.

The Permittees must sort, size-reduce, segregate, and repack mixed waste at TA-54 to meet the waste acceptance criteria for disposal at the Waste Isolation Pilot Plant located in Carlsbad, New Mexico. During this process, some wastes will require treatment using neutralization and absorption to remove EPA Hazardous Waste Numbers D001 and D002. In addition, some wastes will require the removal of aerosol cans to remove the D003 code. The aerosol cans will be removed/segregated from the waste stream and sent off-site for treatment and disposal.

The changes described in the request do not substantially alter the permitted container storage requirements or facility and add only permit conditions to describe the treatment process and associated waste management requirements. This permit modification request adds mobile equipment and treatment processes to an already existing permitted container storage unit that has been previously used for processing and repackaging of waste. The storage capacity of the unit will not be increased by this permit modification, and the permit modification will not significantly change the overall waste processing operations at the facility. Past waste processing at the facility includes container repackaging, sorting, and segregating.

This permit modification request was prepared for review and approval by NMED pursuant to 20.4.1900 New Mexico Administrative Code, incorporating 40 CFR 270.42(a). Upon approval of this Class 1 permit modification request, the modification will be put into effect and notice will be sent to the NMED-HWB-maintained LANL facility mailing list in accordance with 40 CFR 270.42(a)(1)(ii) within 90 days of approval of this request.

If you have questions, please contact Emily Day at (505) 695-4243 (emily.day@em-la.doe.gov) or Arturo Duran at (505) 257-7907 (arturo.duran@em.doe.gov).

Sincerely,

Joseph Murdock
Program Manager
Environment, Safety and Health
N3B-Los Alamos

Sincerely,

Arturo Q. Duran Digitally signed by Arturo Q. Duran
Date: 2021.04.06 14:22:15 -06'00'

Arturo Q. Duran, Compliance and Permitting Manager
Office of Quality and Regulatory Compliance
Environmental Management
Los Alamos Field Office

Enclosure(s): Three hard copies with electronic files:

1. Class 1 Permit Modification Request Requiring Prior Approval for Treatment of Hazardous Waste at TA-54-0412 for Los Alamos National Laboratory Hazardous Waste Facility Permit, EPA ID No. NM0890010515 (EM2021-0037)

cc (letter and enclosure[s] emailed):
Laurie King, EPA Region 6, Dallas, TX
Chris Catechis, NMED-DOE-OB
Steve Yanicak, NMED-DOE-OB
Siona Briley, NMED-HWB
Neelam Dhawan, NMED-HWB
Mitchell Schatz, NMED-HWB
Caitlin Stone, NMED-HWB
Karen Armijo, NA-LA
Peter Maggiore, NA-LA
Adrienne Nash, NA-LA
Gabriel Pugh, NA-LA
Thomas Aug, EM-LA
M. Lee Bishop, EM-LA
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Stephen Hoffman, EM-LA
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Public Reading Room (EPRR and HPRR)
PRS website

April 2021
EM2021-0037

Class 1 Permit Modification Request Requiring Prior Approval for Treatment of Hazardous Waste at TA-54-0412 for Los Alamos National Laboratory Hazardous Waste Facility Permit, EPA ID No. NM0890010515

N3B Los Alamos

CERTIFICATION

NEWPORT NEWS NUCLEAR BWXT-LOS ALAMOS, LLC

Class 1 Permit Modification Request Requiring Prior Approval for Treatment of Hazardous Waste at TA-54-0412 for Los Alamos National Laboratory Hazardous Waste Facility Permit, EPA ID No. NM0890010515

CERTIFICATION STATEMENT OF AUTHORIZATION

In accordance with the New Mexico Administrative Code Title 20, Chapter 4, Part 1 (incorporating the Code of Federal Regulations, Title 40 CFR § 270.11):

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

April 5, 2021

Joseph Murdock
Environment, Safety and Health Program Manager
Newport News Nuclear BWXT-Los Alamos, LLC

Date

Arturo Q. Duran

Digitally signed by Arturo Q. Duran
Date: 2021.04.06 14:22:40 -06'00'

Arturo Q. Duran, Permitting and Compliance Manager
Office of Quality and Regulatory Compliance
Environmental Management
Los Alamos Field Office

Date

CONTENTS

Appendixes

1.0 INTRODUCTION

This document requests a Class 1 permit modification to the Los Alamos National Laboratory (LANL) Hazardous Waste Facility Permit (Permit) issued to the U.S. Department of Energy (DOE), Triad National Security, LLC; and Newport News Nuclear BWXT-LA (N3B), collectively the Permittees, in November 2010. The U.S. Environmental Protection Agency (EPA) ID number for this facility is NM0890010515. This Class 1 permit modification request has been prepared in accordance with 40 Code of Federal Regulations (CFR) 270.42(a)(2), Appendix I, Item F.1.c. This regulation allows for the modification of a hazardous waste facility permit with prior approval from the regulatory agency to add a treatment process that is necessary for treatment of hazardous wastes that are restricted from land disposal to meet some or all applicable treatment standards. This permit modification proposes the addition of a treatment process for mixed waste within a Resource Conservation and Recovery Act (RCRA) permitted facility in the event that liquids or other items are encountered that may carry the hazardous waste characteristics of ignitability, corrosivity, and reactivity (D001, D002, and D003). This permit modification request has been drafted for review and approval by the New Mexico Environmental Department (NMED) pursuant to the New Mexico Administrative Code 20.4.1.900 incorporating 40 CFR 270.42(a).

2.0 BACKGROUND

The Permit was previously modified (N3B-20-0007, June 29, 2020) to include stabilization in containers at TA-54-0231, Outdoor Permitted Unit. Part 7 was modified to describe the requirements for stabilization in containers at TA-54-0231. The proposed stabilization process at TA-54-0412 will be subject to the same requirements. Text describing incorporation of the treatment processes for stabilization (including absorption) and neutralization of hazardous waste to remove D001, D002, and D003 waste codes at TA-54-0412 is proposed within the Permit “Attachment A, Technical Area (TA) - Unit Descriptions” (see Appendix A).

The primary type of hazardous waste stream to be treated is from the S3000 waste matrices, which consist of S3100 Inorganic Homogeneous Solids, S3200 Organic Homogeneous Solids, and S3900 Solidified Inorganics, S4000 Soil/Gravel, and the S5000 (Debris) waste matrix, which consists of S5400 Heterogeneous Debris Waste. These translate to the CIN01, CIN02, CIN03, CIN04, MHD01, MHD03, MHD04, MHD05, MHD08, MHD09, MIN02, MIN03, MIN04, MIN05, and MIN06 waste streams. The waste streams to be treated are from historical processes and recovery operations. MLLW waste streams may be homogeneous or heterogeneous as defined in the Permit Section C.1.2.1. The waste streams will vary depending on the historical process. In some cases, the liquids within these containers have been characterized as hazardous waste with the characteristics of D001 and D002. The aerosol can waste includes waste containers with liquids, which has been characterized as hazardous waste with the characteristics of ignitability (D001) and reactivity (D003).

To remove the D001 and D003 code, aerosol cans will be removed/segregated from the waste stream and sent off-site for treatment and disposal.

There are no changes necessary to the storage and transport processes described within Permit Part 3 (Storage in Containers) and Permit Attachment A [Technical Area (TA) - Unit Descriptions] to implement the proposed treatment processes for mixed waste with liquids. Waste containers are transported to the permitted unit by flatbed trucks, closed-box trucks, or trailers. The permitted unit has design features (currently described in Attachment A, A.4.2.2, Pad 1) that promote safe unloading and handling of waste containers from these trucks and trailers. Waste containers will be stored at the units in accordance with the conditions outlined in Permit Part 3 and all applicable subsections.

The Permittees propose to conduct treatment by stabilization (including absorption) and neutralization at a permitted container storage unit located at TA-54, Area G, Pad 1, Building 412. Waste containers will be transported from permitted container storage units within TA-54 to TA-54-0412 by forklifts (using drum grapplers, when appropriate), flatbed trucks, closed-box trucks, or trailers. Dome TA-54-0412 has routinely been used for waste sorting, segregation, and size reduction activities. To maintain safety and compliance, the activities necessary to treat these wastes have been extensively researched, and the path forward described herein has been established for the wastes.

Information regarding the Permittees' recharacterization efforts, evaluation and testing of effective treatment methods, and evaluation of locations and physical methods to conduct treatment processes is provided in the following documents:

- DOE/WIPP (U.S. Department of Energy/Waste Isolation Pilot Plant), July 2017. "Basis of Knowledge for Evaluating Oxidizing Chemicals in TRU Waste," U.S. Department of Energy document DOE/WIPP-17-3589, Carlsbad, New Mexico. Note: This Basis of Knowledge (BoK) is from the "Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant, Appendix H, Enhanced Acceptable Knowledge," U.S. Department of Energy document DOE/WIPP-02-3122.
- Haschke, J., Allen, T., and Morales, L. "Surface and Corrosion Chemistry of Plutonium," Los Alamos Science, no. 26 (2000), 253-273. Jozefaciuk, G., Bowanko, G. "Effect of Acid and Alkali Treatments on Surface Areas and Adsorption Energies of Selected Minerals," Clays and Clay Minerals 50, no. 6 (2002), 771-783.
- LANL (Los Alamos National Laboratory), March 2016. "Assessment of Options for the Treatment of Nitrate Salt Wastes at Los Alamos National Laboratory – 16541," Los Alamos National Laboratory document LA-UR-15-29314, Los Alamos, New Mexico.
- LANL (Los Alamos National Laboratory), October 2017. "Summary Report of Comprehensive Laboratory Testing to Establish the Effectiveness of Proposed Treatment Methods for Unremediated and Remediated Nitrate Salt Waste Streams, Los Alamos National Laboratory document LA-UR-17-23322, Los Alamos, New Mexico.
- Schoen, J., June 12, 2017. "Chemical Compatibility Evaluation for Waste Stream LA-CIN01.001," AK Source Document CCE03, Revision 0. (Note: This author is a Central Characterization Program [CCP] Acceptable Knowledge Expert.)

3.0 PERMIT MODIFICATION BASIS

This permit modification request has been prepared in accordance with the 40 CFR 270.42(a)(2), Appendix I, Item F.1.c. This regulation allows for the modification of a hazardous waste facility permit with prior approval from the regulatory agency to add treatment processes that are necessary for treatment of hazardous wastes that are restricted from land disposal to meet some or all applicable treatment standards. It is necessary for the Permittees to treat these wastes to remove the RCRA hazardous waste characteristics of ignitability, corrosivity, and reactivity. According to the criteria of Appendix I, the addition of this treatment process can be incorporated into the Permit using a Class 1 modification requiring prior regulatory agency approval. This process is appropriate because the only changes proposed to the permitted storage unit are related to the addition of the treatment process and are limited to the stated purpose of the class description. Storage volumes would not increase as a result of this permit modification.

4.0 DESCRIPTION

This permit modification request proposes changes to a permitted unit at TA-54-0412. All proposed changes are shown in redline-strikeout format for proposed revisions to text in Permit Part 7 and the following Permit attachments:

- Attachment A, Technical Area (TA) - Unit Descriptions (changes shown in redline)
- Attachment C, Waste Analysis Plan (changes shown in redline)
- Attachment E, Inspection Plan (changes shown in redline)
- Attachment G.6, Technical Area 54, Area G, Pad 1, Outdoor Container Storage Unit Closure Plan (changes shown in redline). This attachment also includes the revised Figure G.6-1.
- Attachment J, Hazardous Waste Management Units (changes shown in redline)
- Revised Figures (Attachment N, Figures 27 and Figure 29, and Figure G.6-1)

Appendix A contains changes to the Permit Part 7 and Attachments A, C, E, G.6, and J. Appendix B contains the replacement figures.

The changes comprise the addition of a treatment process at TA-54-0412 for MLLW and MTRU waste from the S3000 (homogeneous solids), S4000 (soil/gravel), and S5000 (debris) waste matrices to remove the RCRA hazardous waste characteristics of D001, D002, and D003. These wastes are currently stored at various permitted units at TA-54, Area G. The waste matrices include but are not limited to (monolithic) solid homogenous waste, cemented sludge wastes, and debris. TA-54-0412 is currently permitted for waste storage.

There are no changes required to the storage and transport processes described within Permit Part 3 (Storage in Containers) to implement the proposed treatment processes for mixed waste with liquids. Waste containers are transported to the permitted unit by flatbed trucks, closed-box trucks, or trailers. The permitted unit has design features (currently described in Attachment A, A.4.2.2, Pad 1) that promote safe unloading and handling of waste containers from these trucks and trailers. Waste containers will be stored at the units in accordance with the conditions outlined in Permit Part 3 and all applicable subsections. Treatment of mixed waste will occur within the pre-engineered containment tent within the TA-54-0412 Permitted Unit. TA-54-0412 provides confinement for the proposed operations and is well configured to safely accommodate the neutralization and stabilization process with zeolite. The pre-engineered containment tent within TA-54-0412 is equipped with a HEPA filtration system and is under negative pressure during waste processing activities.

No changes are required to Attachment B, Part A Application Form, because waste treatment process code T04 for “Other Treatment” was added to the Process Codes and Design Capacities for TA-54, Area G, in the Class 1 Permit Modification for TA-54-0231 approved by NMED on June 29, 2020.

4.1 Safety and Traffic

4.1.1 Vehicle Traffic Control within TA-54, Area G

Roadways are kept in good condition, and the area has a posted speed limit of 15 mph. During internal waste receipt and offloading activities, additional traffic restrictions such as prohibiting traffic and assigning station flaggers are employed as a safety precaution. During elevated waste movements (e.g., lifting the waste container from the ground to the flatbed truck), supporting controls such as use of spotters are implemented. Vehicle barriers are strategically located throughout TA-54, Area G, to protect

stored waste. Vehicles vary in size from small utility trucks to large earthmoving equipment. Vehicle traffic volume is low-to-moderate because of access requirements and physical layout. All vehicle traffic access to the Pajarito corridor and TA-54 is restricted to badged personnel only.

4.1.2 Waste Movement Controls

Waste containers are transported to the permitted unit by flatbed truck, closed-box truck, or trailer. The permitted unit has design features that promote safe unloading and handling of waste containers from these trucks and trailers. Waste containers will be stored at the units in accordance with the conditions outlined in Permit Part 3 and all applicable subsections. A forklift or other manual, mechanical, or hydraulic drum-handling equipment will be used to move containers stored at permitted units at TA-54, Area G. Palletized drums will be handled with a forklift equipped with tines or other types of mechanical or hydraulic drum-handling equipment. Individual drums of waste will be manipulated with a drum-grapple attachment on the forklift or other manual, mechanical, and hydraulic drum-handling equipment. Small containers will be handled manually or with a dolly.

4.1.3 Distance from Property Boundary

Hazardous wastes, specifically D001 and D003 wastes, will be treated at a distance of at least 120 ft from the north TA-54 property fence and inside the confinement unit in TA-54-0412.

4.1.4 Safety Basis Summary

N3B has a rigorous safety program (including a safety basis) that includes an industrial health and safety program and additional safety management programs. Some of the additional safety management programs are also found in the safety basis, but others act independently from the safety basis requirements. The safety basis covers worker safety as required by DOE-STD-3009-94 and other DOE standards and orders. It refers frequently to various safety management programs such as the radiation protection program and the hazardous material and waste management program. The safety basis is required by 10 CFR 830, Subpart B, and is regulated by DOE, which is subject to the requirements of the Price Anderson Amendment Act. The safety basis is also upheld by technical safety requirements that consist of derived controls for the protection of the public, the worker, and the collocated worker.

During waste operations at TA-54, N3B is required to abide by safety procedures and policies that include (1) N3B-SD100, “Integrated Safety Management System,” (2) N3B-P300, “Integrated Work Management,” and (3) N3B-PD100, “10 CFR 851 Worker Safety and Health Program.”

4.2 Treatment by Neutralization and Stabilization in Containers

Neutralization (via pH adjustment) will be utilized when necessary as pretreatment prior to the stabilization process to ensure the liquid waste falls within a pH range in which the zeolite absorbs most efficiently. The treatment process described herein includes verifying pH, and if necessary, adding an appropriate amount of hydrochloric acid (HCl) or sodium hydroxide (NaOH) and then stabilizing the liquid waste by absorbing with zeolite. The HCl or NaOH is used to bring the pH of the liquid waste to within the 3–10 range so that the zeolite can perform optimally. If liquid waste is outside of the optimal 3–10 pH range, HCl or NaOH will be added incrementally and iteratively to liquid waste. The liquids will then be stabilized with zeolite to a minimum ratio of 3:1 (three parts zeolite to one part liquid waste). Treatment will occur under mobile fume hoods for 55-gal. and 85-gal. drums. The fume hoods are attached to the ventilation system when in use.

The Permittees intend to utilize the HALO Smart Electrode HI12302 polyetherimide gel-filled Bluetooth for potentiometric pH measurements to establish the initial and final pH during the neutralization process. NMED approved this alternative method on October 22, 2020, for use at TA-54-0231, and the Permittees therefore respectfully request that the same alternative methodology be allowed for use at TA-54-0412 to facilitate operational efficiency. The Permittees also respectfully request that, as part of this permit modification request, NMED review and approve the use of another method equivalent to method SW-846 9040C, "pH Electrometric Measurement," as specified in Attachment C, Subsection C.3.2.4.1. Specifically, the Permittees wish to perform potentiometric pH measurements using the HI98190 Professional Waterproof Portable pH/ORP Meter. This method meets the specification requirements outlined in SW-846 9040C for operation. Appendix C is a letter from Hanna Instruments, the manufacturer of the HI98190 Professional Waterproof Portable pH/ORP Meter, and Appendix D is the manual for the HI98190 Professional Waterproof Portable pH/ORP Meter.

In cases where there is insufficient volume of liquid waste, the neutralization step of the treatment process will not be performed, and these minute quantities of liquids will only be stabilized with zeolite or a WIPP-approved absorbent.

Debris within the waste containers will not require additional treatment and will be either placed back into the parent waste container or directly into the daughter container with the treated waste. Debris waste may be stored temporarily in a container within TA-54-0412 or resized as necessary to be packaged in a waste container. Any cellulosic material found within the parent container will be treated with zeolite at a 3:1 zeolite ratio. Prohibited items such as aerosol cans will be segregated and may be stored temporarily in a container within TA-54-0412 for repackaging.

The treated waste will be repackaged into a new, certified 55-gal. container and characterized by Central Characterization Program (CCP) personnel in accordance with the WIPP Waste Acceptance Criteria (WAC) and the WACs of other receiving facilities. Waste removed from the parent container will be treated as designated and repackaged into a daughter container. All contents of a single waste container will be processed, or treated if necessary, within a single shift. If the contents cannot be treated within a single shift, the waste will not be left unattended mid-treatment. Instead, the waste containers (parent and daughter) will be closed.

4.2.1 Post Treatment

All treated waste will be packaged into containers, and the characteristics of D001, D002, and D003 will be removed from the waste streams to meet the required waste treatment standards. The containerized treated waste will be placed back into storage at TA-54, Area G, to await final disposal.

5.0 DISCUSSIONS OF PROPOSED CHANGES TO THE PERMIT

Proposed changes to the Permit are described below and are shown in redline-strikeout formatting within Appendix A of this document. Microsoft Word files of the proposed permit revisions are included on CD as Appendix E.

5.1 Part 7, Stabilization in Containers

Proposed permit conditions for treatment by neutralization and stabilization have been included in Part 7 of the Permit, "Stabilization in Containers." The Permittees propose that TA-54-0412 be added to the text within this part of the Permit for stabilization in containers.

5.2 Attachment A, Technical Area (TA) - Unit Descriptions

Descriptive text revisions identified in Attachment A, section A.4.2.2, include

- changes to the title of the TA-54-0412 Outdoor Permitted Unit to indicate that it is a storage and treatment unit,
- addition of a description of the equipment used for treatment at the TA-54-0412 Outdoor Permitted Unit,
- changes to the description of the treatment process flow at the TA-54-0412 Outdoor Permitted Unit, and
- correction of a typographical/formatting error in Section A.4.2.2.

5.3 Attachment C, Waste Analysis Plan

In this attachment to the Permit, descriptions that characterize wastes prior to treatment at TA-54-012, and descriptions of sampling and analysis for verification of treatment methodology, have also been included within section C.3.2.4, “Characterization Procedures Prior to and after Treatment of Mixed TRU Waste,” and associated subsections. There are no changes required to the waste sampling or analysis methods associated with this permit modification request. Table C-17, “Summary of Characterization Methods: Mixed Low-Level Waste”, and Table C-18, “Summary of Characterization Methods for Mixed Transuranic Waste,” have been revised to include the alternative methods of pH verification prior to stabilization. Table C-20, “Description of Stabilization Waste Streams at Technical Area 54, Building 0412,” has been revised to add TA-54-0412 and reflect the addition of waste stream descriptions for wastes to be stabilized in containers.

5.4 Attachment E, Inspection Plan

Attachment E, TA-54 Inspection Plan, has been modified to include the stabilization unit at TA-54-0412.

5.5 Attachment G.6, Technical Area 54, Area G, Pad 1, Outdoor Container Storage Unit Closure Plan

Throughout Attachment G.6, changes have been made to reflect that the unit will be utilized for treatment as well as storage of waste. Figure G.6-1, “Technical Area 54, Area G, Pad 1, Outdoor Container Storage Unit Grid Sampling and Additional Sampling Locations,” was also revised to reflect that it is a storage and treatment unit and to show the location of the pre-engineered containment tent.

5.6 Attachment J, Hazardous Waste Management Units

Table J-1, “Active Portion of the Facility, in Permit Attachment J,” was changed to reflect the addition of a treatment process to the TA-54-0412 Outdoor Permitted Unit within the Process Codes, Operating Capacity, and General Information columns of the table.

5.7 Attachment N, Figures

Figures 27 and 29 in Attachment N have been updated to include the footprint of the TA-54-0412 confinement unit and a description of its usage as a storage and treatment unit.

Appendix A

Redline Pages of Hazardous Waste Facility Permit, Part 7, Attachment A, Attachment C, Attachment E, Attachment G.6, and Attachment J

ATTACHMENT A

TECHNICAL AREA (TA) - UNIT DESCRIPTIONS

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A.5.10 Mixed Waste Storage Tank System
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A.6.8 Required Equipment
484~~746~~

A.6.9 Control of Run-on/Run-off
504~~948~~

A.6.10 Subsurface Vapor Monitoring

504~~948~~

Within the Perma-Con unit, glove bags will be used to enclose a contaminated item and form a small work area to confine the spread of contamination. Glove bags will allow work to be performed on potentially contaminated items, provide protection to personnel, and will allow access to waste within the containment using gloved sleeves, which will enable repackaging or manipulations without directly contacting contaminated surfaces.

The neutralization process will consist of verifying pH and adding hydrochloric acid (HCl) or sodium hydroxide (NaOH) incrementally and iteratively to aqueous waste to bring the waste to within a 3-10 pH range. Pourable liquids in the waste drums will have their pH measured using a calibrated pH meter prior to the neutralization process. –The Permittees will generally follow EPA method 9040C (as updated) for pH Electrometric Measurement of pH testing. However, because of the need for "real-time" pH screening results at the time of waste processing, strict adherence to all aspects of EPA method 9040C or an equivalent method, if approved in advance by NMED will be followed. The liquids will be neutralized, if necessary, and stabilized with zeolite in a minimum ratio of 3:1 (three parts zeolite to one-part liquid waste). The treated waste will be repackaged into a new certified 55-gal. daughter drum and characterized by Central Characterization Program (CCP) personnel in accordance with the WIPP Waste Acceptance Criteria (WAC). All measuring tools used in stabilization processes (*i.e.,* glass/plastic pipettes, graduated cylinders, beakers, etc.) will be resistant to a wide variety of reagents.

In cases where there is insufficient volume of liquid waste, the neutralization step of the treatment process will not be performed and these minute quantities of liquids will only be stabilized with zeolite or a WIPP-approved absorbent.

Drill and drain operations will be located in the cell separate from where glove bag operations are taking place. The drum liner will be de-nested and punctured, and the sludge or liquid will be suctioned and drained out. The collected liquid will be characterized, neutralized (if necessary), and treated with zeolite or a WIPP-approved absorbent. For free liquids observed between the liner and the existing parent drum, de-nesting operations will take place via gantry crane and the liquid will be collected, characterized, neutralized (if necessary), and stabilized with zeolite or a WIPP-approved absorbent.

A.4.2.2 ~~**For free liquids observed between the liner and the existing parent drum, de-nesting operations will take place via gantry crane and the liquid will be collected, characterized, neutralized (if necessary), and stabilized with zeolite or a WIPP-approved absorbent.**~~ **Pad 1**

The 4 to 6 inch thick asphalt pad is approximately 358 feet long and 213 feet wide. TA-54-412 is located on the pad in the northeastern portion of Area G (*see* Figure 29 in Attachment N (*Figures)*).

TA-54-412 (*see* Figure 29 in Attachment N (*Figures)*) is a one story building that is approximately 220 feet long by 60 feet wide (13,200 ft^2). It consists of two structures, an internal primary confinement structure that houses the DVRS processing operations and an

external secondary confinement structure which surrounds the primary confinement structure. The external secondary confinement structure (hereinafter referred to as "building") provides protection from the elements and a temperature-controlled space for the internal structures and associated process equipment. A 16 ft by 16 ft roll-up vehicle-access door is located on the north end of the building. The roll-up vehicle access door opens to the secondary confinement structure area and serves as a pass-through for moving DVRS feed-stock waste into the primary confinement structure. There is also vehicle access on the south end of the building for removal of compacted waste from DVRS operations. The concrete slab provides a structural foundation for the building and the shearer and baler system and provides a direct working surface for movement of fiberglass reinforced plywood boxes and processing equipment. The concrete slab is above grade to direct potential run-on away from the building. The floor in the building is sloped to a sump that has a grating cover to provide traction and a level working surface. The sump is treated with chemical-resistant epoxy filler-sealer and protective coating.

The primary confinement structure is housed entirely within the building and consists of five interconnected enclosures or cells. The system is approximately 150 feet long by 50 feet wide by 16 feet high and sits directly on the sealed concrete floor. The primary confinement structure is constructed of 6-inch-thick, two-hour fire-rated sandwich panels made of 16-gauge steel and gypsum wallboard measuring 40 feet wide by 4 or 8 feet long. The structure interlocks in a self-supporting steel framework that can be assembled into multiple configurations. The primary confinement structure has five cells each of which is used for a specific function of the DVRS process. The cells are equipped with both personnel and large roll-up doors so that personnel, equipment, and material can access the structure and move from one cell to the next. A cell is used to sort and segregate transuranic and mixed transuranic waste and contains various tools used to dismantle the fiberglass reinforced plywood boxes. Other cells are used for decontamination and packaging and a final cell contains the shearer and baler used to compact waste items. The shearing and baling process takes place within a tightly sealed compartment. Waste containers that need to be dismantled are processed using circular saws, reciprocating saws, hammers, pry bars, and other tools, as needed. Waste containers are moved with trucks, forklifts, air pallets, and hand dollies. The primary and secondary confinement structures are built to meet criteria specified in DOE-STD-1020-92, "*Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities"* (DOE, 1992) for Performance Criteria 2 structures. Performance Criteria 2 structures include active fire suppression, emergency communications, and confinement systems that provide important safety functions related to emergency handling or hazard recovery and are designed to protect the health and safety of workers and visitors during active operations. The building contains fire protection piping and heating, ventilation, and air conditioning ducting and is a two-hour code-compliant fire-rated building. Panels in the primary confinement structure are the same material as the two-hour fire-rated wall construction with additional supports. A dry-pipe fire-protection system provides coverage for the primary confinement structure. A water collection area in the south end of the building provides for containment of any potential leaks, spills, or accumulated water resulting from the activation of the fire protection system.

Northwest Bay of Building 412

Waste treatment, storage, and repackaging are performed in a pre-engineered containment tent adjacent to the primary confinement structure located in the northwest bay of building 412 (Attachment N, Figure 27). The containment tent measures approximately 30 ft long by 27 ft wide by 15 ft high. The containment tent is equipped with a HEPA filtration system and a fire-detection system. Additional emergency and safety equipment for building 412 are listed in Attachment D, Contingency Plan. Attached to the containment tent are a radiological buffer area (RBA), dress-out room, and control room. The RBA measures 15 ft long by 10 ft wide. The RBA entrance allows safe transport of containers into the containment tent. Waste-handling activities do not take place within the dress-out room or the control room. The dress-out room measures approximately 10 ft wide by 20 ft long. The control room measures approximately 10 ft wide by 17 ft long.

Mobile equipment such as gantry cranes, fume hoods, dedicated ventilation units, drum shakers, and drum lifts are used in the treatment and repackaging processes. Containers holding hazardous or mixed waste with free liquids will be stored on portable spill pallets or pans. Containers vary in size and will determine the quantity of waste to be treated. These include 55-gal. drums, 85-gal. drums, and standard waste boxes (SWBs).

Waste characterization data shall be used to determine whether waste is amenable to stabilization and whether pretreatment via neutralization is necessary. Neutralization may be performed as a pre-treatment option via pH adjustment to facilitate subsequent treatment via stabilization with zeolite.

When deemed necessary, neutralization will be performed in containers in the containment tent within TA-54-0412. Whenever possible, treatment will take place within the existing fume hoods to protect human health and the environment. The neutralization step will consist of verifying pH and adding hydrochloric acid (HCl) or sodium hydroxide (NaOH) to bring the waste within a pH range of 3–10 to ensure that waste is amenable to stabilization with zeolite. The liquids will then be stabilized with zeolite with a minimum ratio of 3:1 (three parts zeolite to one part liquid waste). In cases where there is insufficient volume of liquid waste, the neutralization step of the treatment process will not be performed, and these minute quantities of liquids will only be stabilized with zeolite or a WIPP-approved absorbent.

Debris waste (i.e., waste containing no liquids) does not require additional treatment and will either be placed back into the parent container or placed directly into the daughter container with the treated waste.

A.4.2.3 Pad 3

The 4 inch thick asphalt pad 3 is approximately 339 feet long and 50 feet wide. Storage Dome 48, located at the eastern end of pad 3, is 285 feet long and 50 feet wide and has a peak height of 24 feet (*see* Figure 30 in Attachment N (*Figures)*). The design and materials of construction for dome 48 are the same as the other domes at TA-54. The dome is equipped with a double-panel rolling door at the south end of the dome and eight personnel doors located approximately every 80 feet along the dome's length mainly to allow for adequate access both by vehicles and personnel. The interior perimeter of the dome is surrounded by a 6-inch-high, 8-inch-wide asphalt curb which helps prevent run-on into, and runoff from, the dome. An asphalt ramp located at the vehicle entrance allows vehicles and container handling

ATTACHMENT C

WASTE ANALYSIS PLAN

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waste characterization determined through VE is recorded in the associated waste's AK documentation.

Standardized training for VE shall be developed. Visual examination operators shall be trained in the specific waste generating processes, typical packaging configurations, and waste material parameters expected to be found in each waste stream at the generator site. The training shall be site specific to include the various waste configurations generated at the site. Operators must requalify at least every two years.

C.3.2.2 Characterization to Meet LDR Requirements

The Permittees shall characterize MTRUW to determine its land disposal restriction status in accordance with Attachment Section C.5.2.

C.3.2.3 WIPP Characterization

Most MTRUW waste at the Facility is destined for disposal at the Waste Isolation Pilot Project (WIPP) in Carlsbad, New Mexico. Therefore, prior to shipment to WIPP, additional characterization to meet WIPP certification procedures will be implemented to meet requirements of the WIPP permit for these wastes. Waste information that is derived from the WIPP waste characterization will be used for Facility MTRUW characterization as additional information for AK.

C.3.2.4 Characterization Procedures Prior to and After Treatment of Mixed TRU Wastes

The Permittees shall adhere to the waste characterization procedures specific to waste treatment in the stabilization unit at TA-55, Building 4, Room 401; for the stabilization process of blending with zeolite at the TA-50, Building 69 (TA-50-0069) Indoor Permitted Unit; and the stabilization/neutralization treatment processes at TA-54, Area G, Pad 9, Dome 231 (TA-54-0231) and TA-54, Area G, Pad 1, Building 412 (TA-54-0412). The stabilization unit at TA-55 is a miscellaneous unit pursuant to 40 CFR Part 264, Subpart X and is used to treat liquid and solid mixed wastes by stabilization in cement to form a noncorrosive solid matrix. The stabilization treatment process at TA-50 occurs within a glovebox at a permitted storage unit and is used to treat liquid and solid mixed waste by blending with water and zeolite to form a noncorrosive and non-ignitable solid matrix. The stabilization treatment process at TA-54-0231 occurs within a glove bag at a permitted storage unit and is used to treat liquid and solid waste by neutralizing pourable liquids and adding zeolite or another Waste Isolation Pilot Plan (WIPP)-approved absorbent to form a noncorrosive and non-ignitable solid matrix. The stabilization treatment process at TA-54-0412 occurs within the pre-engineered containment tent within TA-54-0412 at a permitted storage unit and is used to treat liquid and solid waste by neutralizing pourable liquids and adding zeolite or another Waste Isolation Pilot Plan (WIPP)-approved absorbent to form a noncorrosive and non-ignitable solid matrix. Treatment will occur under fume hoods for 55-gallon and 85-gallon drums. The fume hoods are attached to the ventilation system when in use.

The stabilization unit at TA-55 treats homogeneous liquid and solid mixed waste generated primarily from R&D and processing and recovery operations at TA-55 and at the Chemistry and

Metallurgy Research Building at TA-3. The liquid wastes (Summary Category Group L1000) generally consist of evaporator bottoms solutions and laboratory solutions that may exhibit the hazardous characteristics of corrosivity and toxicity for metals (including arsenic, barium, cadmium, chromium, lead, mercury, and silver) as defined in 40 CFR §§ 261.22 and 261.24, which are incorporated herein by reference. The homogeneous solid process wastes (Summary Category Group S3000) consist of process residue from the evaporator, process leached solids, filter cake, and other miscellaneous solids. This waste stream typically exhibits the hazardous characteristic of toxicity (for metals) and corrosivity. These waste streams are mixed with cement in 55-gallon drums and allowed to cure into a noncorrosive solid matrix. Table C-19 provides a description of the waste streams associated with the stabilization unit and identifies their potentially applicable EPA Hazardous Waste Numbers. The resulting cemented waste is identified by Summary Category Group S3000 and typically carries the Waste Matrix Code S3100.

The glovebox at the TA-50-0069 Indoor Permitted Unit is used to treat nitrate salt-bearing waste by stabilization in containers. Liquids and solid waste that exhibit the hazardous characteristics of ignitability, corrosivity (for liquids only), and toxicity for metals (including arsenic, barium, cadmium, chromium, lead, mercury, and silver) as defined in 40 CFR §§261.22 and 261.24, which are incorporated herein by reference, are treated at the unit to remove only the ignitability and corrosivity characteristics. Table C-20 provides a description of the waste streams associated with the stabilization within a bowl in a glovebox located within in TA-50-0069 and the stabilization (including absorption) and neutralization inside a Perma-Con in building TA-54-0231, and identifies their potentially applicable EPA Hazardous Waste Numbers prior to treatment. After treatment, only the EPA Hazardous Waste Numbers for ignitability and corrosivity (D001 and D002) will be removed from the treated waste. All other Hazardous Waste Numbers will still apply to the treated waste.

The Permitted Units at TA-54-0231 and TA-54-0412 ~~is~~ are used to treat mixed transuranic waste from the S3000 waste matrix (homogenous solids) to remove the Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics of ignitability (D001), corrosivity (D002) and reactivity (D003). Treatment of cemented sludge waste will occur within glove bags located inside the Permitted Unit, a Perma-Con in TA-54-0231. At TA-54-0412, treatment of waste will occur within the pre-engineered containment tent within Building 412. Treatment activities include neutralization of liquids, and stabilization of liquids using zeolite or another WIPP-approved absorbent. Table C-20 provides a description of the waste streams associated with the stabilization (including absorption) and neutralization inside a glove bag located within a Perma-Con in TA-54-0231 and within the pre-engineered containment tent in TA-54-0412; and identifies their potentially applicable EPA Hazardous Waste Numbers (HWNs) prior to treatment. After treatment, only the EPA HWNs D001 and D002 will be removed from the treated waste. To remove the D003 HWN, aerosol cans will be removed/segregated from the waste stream and sent off-site for treatment and disposal. All other HWNs that have not been removed by treatment or segregation will still apply to the treated waste.

C.3.2.4.1 Characterization Procedures for Waste to Be Treated by Stabilization

The Permittees shall conduct chemical and physical characterization prior to treatment of MTRUW. The Permittees shall use documented AK, as described in Attachment

Section C.3.1.1, to determine whether or not the waste stream is regulated as a hazardous waste. The Permittees shall use process knowledge, chemical analytical data, or both to adequately characterize the MTRUW prior to stabilization and neutralization, if necessary (at TA-54-0231 and TA-54-0412 only). If process information is not sufficient, the Permittees shall periodically sample and analyze the wastes to be treated by stabilization for pH and for TC metals listed in 40 CFR § 261.24 to establish a baseline, as appropriate. Based on documented AK, the wastes treated by stabilization at TA-55 do not contain VOCs or SVOCs. Parameters and analytical methods for specific hazardous constituents are presented in Table C-18.

The neutralization process will consist of verifying the pH and adding hydrochloric acid (HCl) or sodium hydroxide (NaOH) incrementally and iteratively to aqueous waste to bring the pH within a 3 -10 range. Pourable liquids in the waste drums will have their pH measured with a calibrated pH meter prior to the neutralization process and will generally follow EPA Method 9040C (as updated), pH Electrometric Measurement for pH testing. However, because of the need for "real-time" pH screening results at the time of waste processing, strict adherence to all aspects of EPA method 9040C may not be possible. The Permittees may use an equivalent method, if approved in advance by NMED. The liquids will be neutralized, if necessary, and stabilized with zeolite in a minimum ratio of 3:1 (three parts zeolite to one part liquid waste). The treated waste will be repackaged into a new certified 55-gal. daughter drum and characterized and certified by Central Characterization Program (CCP) personnel in accordance with the WIPP WAC. All measuring tools used in the stabilization process (*i.e.,* glass/plastic pipettes, graduated cylinders, beakers, etc.) must be resistant to a wide variety of reagents.

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C.3.2.4.2 Characterization Procedures for Waste Treated by Stabilization

The Permittees shall characterize waste treated by stabilization (*i.e.*, MTRUW) in accordance with Attachment Section C.3.2. For treatment at the TA-50-0069 Indoor Permitted Unit, samples will be collected from a minimum of 1% of treated waste containers from each waste stream and analyzed at an onsite laboratory to confirm chemical composition when compared to that of the surrogates tested.

NMED may require additional sampling of waste from the TA-54-0231 and TA-54-0412 treatment processes.

C.3.2.5 Sample Handling, Preservation, and Storage

Table C-15 presents the most recent *SW-846* requirements regarding sample containers, preservation techniques, and holding times associated with sample collection. The Permittees shall adhere to these requirements to ensure that sampling and analysis meet quality objectives for data.

C.4 OFF-SITE WASTE ACCEPTANCE PROCEDURES

For off-site waste, the Permittees shall require the generator to provide waste characterization documentation equivalent to that prepared by the Permittees for waste generated on site. The

Table C-17 (continued)

Parameter	Method Numbers	Test Method	Rationale
Liquid Wastes (cont.)			
RCRA-regulated metals in waste: Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver	*SW-846* (1311, 6010B, 7060A, 7061A)[c] (1311, 6010B, 7080A, 7081)[c] (1311, 6010B, 7130, 7131A)[c] (1311, 6010B, 7190, 7191)[c] (1311, 6010B, 7420, 7421)[c] (1311, 6010B, 7470A, 7471A, 7472)[c] (1311, 6010B, 7740, 7741A, 7742)[c] (1311, 6010B, 7760A, 7761)[c] or equivalent methods[d]	Total and/or TCLP Inductively-coupled plasma atomic emission spectroscopy Atomic absorption Manual cold vapor atomic absorption Anodic stripping voltammetry Acceptable Knowledge	Determine total and/or TCLP concentration in samples of liquid
Ignitability (Flash Point)	*SW-846* (1010, 1020A, 1030)[c] or equivalent methods[d]	Pensky-Martens closed cup Setaflash closed cup Acceptable Knowledge	Determine ignitability
pH (Corrosivity)	*SW-846* (9040B, 9041A, 9045C)[c] or equivalent methods[d] Equivalent methods: *HALO Smart Electrode HI12302 polyetherimide gel-filled Bluetooth* (TA-54-0231 and TA-54-0412 units only) *HI98190 Professional Waterproof Portable pH/ORP Meter* (TA-54-0231 and TA-54-0412 units only)	pH electrometric Measurement pH paper Soil and waste pH Acceptable Knowledge	Determine corrosivity

[a] American Society for Testing and Materials, 1991, "Standard Practice for Sampling Waste and Soils for Volatile Organic Compounds," ASTM D4547-91, *Annual Book of ASTM Standards*, Philadelphia, Pennsylvania, American Society for Testing and Materials

[b] U.S. Environmental Protection Agency (EPA), 1991, "Soil Sampling and Analysis for Volatile Organic Compounds," EPA 154014-91991, Office of Research and Development

[c] U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*

[d] Equivalent methods, subject to EPA approval, may be substituted

Parameter	Method Numbers	Test Methods	Rationale
Treatment			
RCRA-regulated metals in waste: Arsenic Barium Cadmium Chromium Lead Mercury Silver	*SW-846* (1311, 6010B, 7060A, 7061A)[c] (1311, 6010B, 7080A, 7081)[c] (1311, 6010B, 7130, 7131A)[c] (1311, 6010B, 7190, 7191)[c] (1311, 6010B, 7420, 7421)[c] (1311, 6010B, 7470A, 7471A, 7472)[c] (1311, 6010B, 7760A, 7761)[c] or equivalent methods[d]	Total and/or TCLP Inductively-coupled plasma atomic emission spectroscopy Atomic absorption Manual cold vapor atomic absorption Acceptable Knowledge	Determine total and/or TCLP metals concentration in samples
pH (Corrosivity)	*SW-846* (9040B, 9041A, 9045C) or equivalent methods[d] Equivalent methods: *HALO Smart Electrode HI12302 polyetherimide gel-filled Bluetooth* (TA-54-0231 and TA-54-0412 units only) *HI98190 Professional Waterproof Portable pH/ORP Meter* (TA-54-0231 and TA-54-0412 units only)	pH electrometric measurement Acceptable Knowledge	Determine corrosivity

[a] American Society for Testing and Materials, 1991, "Standard Practice for Sampling Waste and Soils for Volatile Organic Compounds," ASTM D4547-91, *Annual Book of ASTM Standards*, Philadelphia, Pennsylvania, American Society for Testing and Materials

[b] U.S. Environmental Protection Agency (EPA), 1991, "Soil Sampling and Analysis for Volatile Organic Compounds," EPA 154014-91001, Office of Research and Development

[c] U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*.

[d] Equivalent methods, subject to EPA approval, may be substituted

Table C-20
Description of Stabilization Waste Streams at Technical Area 50, Building 69~~,~~ ~~and~~ Technical Area 54, Dome 231; and Technical Area 54, Building 412

(This table is for informational purposes only)

Summary Category Group	Waste Matrix Code	Waste Description[a]	Waste-Generating Activity	Basis for Hazardous Waste Designation	Potential EPA Hazardous Waste Numbers	Potential Hazardous Waste Constituents and /or Characteristics	Regulatory Limits[b] (milligrams per liter)	Potential Underlying Hazardous Constituents[c]
S3000 - Homogeneous	S3100	Homogeneous Inorganic, Cemented	Plutonium processing operations	Acceptable Knowledge	D001 D002 D003[e] D004 D005 D006 D007 D008 D009 D010 D011 D018 D019 D021 D022 D035 D038 D039 D040 F001 F002 F003 F004[e] F005 F006[e] F007[e] F008[e]	Ignitable Corrosive Reactivity Arsenic Barium hydroxide Cadmium Chromium Lead Mercury Selenium Silver Benzene Carbon tetrachloride Chlorobenzene Chloroform Methyl ethyl ketone Pyridine Tetrachloroethylene Trichloroethylene Spent halogenated solvents Spent halogenated solvents Spent non-halogenated solvents Spent non-halogenated solvents Spent non-halogenated solvents Wastewater treatment sludges Spent cyanide plating solutions Spent strip/clean solutions	NA[d] NA[d] NA[d] 5.0 100.0 1.0 5.0 5.0 0.2 1.0 5.0 0.5 0.5 100.0 6.0 200.0 5.0[e] 0.7 0.5 NA[d] NA[d] NA[d] NA[d] NA[d] NA[d] NA[d] NA[d]	
		Homogeneous Inorganic, Cemented Organics	Plutonium processing operations	Acceptable Knowledge				
		Homogeneous Inorganic, Non-cemented	Plutonium processing operations	Acceptable Knowledge				
		Homogeneous Inorganic, Salts	Plutonium processing operations	Acceptable Knowledge				

Table C-20 (continued)
(This table is for informational purposes only)

Summary Category Group	Waste Matrix Code	Waste Description[a]	Waste-Generating Activity	Basis for Hazardous Waste Designation	Potential EPA Hazardous Waste Numbers	Potential Hazardous Waste Constituents and/or Characteristics	Regulatory Limits[b] (milligrams per liter)	Potential Underlying Hazardous Constituents[c]
S3000 - Homogeneous	S3100	Homogeneous Inorganic, Vermiculite	Plutonium processing operations	Acceptable Knowledge	D001	Ignitable	NA[d]	
					D002	Corrosive	NA[d]	
					D003[e]	Reactivity	NA[d]	
					D004	Arsenic	5.0	
					D005	Barium hydroxide	100.0	
					D006	Cadmium	1.0	
					D007	Chromium	5.0	
					D008	Lead	5.0	
					D009	Mercury	0.2	
					D010	Selenium	1.0	
					D011	Silver	5.0	
					D018	Benzene	0.5	
					D019	Carbon tetrachloride	0.5	
					D021	Chlorobenzene	100.0	
					D022	Chloroform	6.0	
					D027	1,4-Dichlorobenzene	7.5	
					D028	1,2-Dichloroethane	0.5	
					D030	2,4-Dinitrotoluene	0.13[e]	
					D032	Hexachlorobenzene	0.13[e]	
					D033	Hexachlorobutadiene	0.5	
					D034	Hexachloroethane	3.0	
					D035	Methyl ethyl ketone	200.0	
					D036	Nitrobenzene	2.0	
					D037	Pentachlorophenol	100.0	
					D038	Pyridine	5.0[e]	
					D039	Tetrachloroethylene	0.7	
					D040	Trichloroethylene	0.5	
					D042	2,4,6-Trichlorophenol	2.0	
					D043	Vinyl Chloride	0.2	
					F001	Spent halogenated solvents	NA[d]	
					F002	Spent halogenated solvents	NA[d]	
					F003	Spent non-halogenated solvents	NA[d]	
					F004[e]	Spent non-halogenated solvents	NA[d]	
					F005	Spent non-halogenated solvents	NA[d]	
					F006[e]	Wastewater treatment sludges	NA[d]	
					F007[e]	Spent cyanide plating solutions	NA[d]	
					F008[e]	Spent strip/clean solutions	NA[d]	

Table C-20 (continued)
(This table is for informational purposes only)

Summary Category Group	Waste Matrix Code	Waste Description[a]	Waste-Generating Activity	Basis for Hazardous Waste Designation	Potential EPA Hazardous Waste Numbers	Potential Hazardous Waste Constituents and/or Characteristics	Regulatory Limits[b] (milligrams per liter)	Potential Underlying Hazardous Constituents[c]
S5000 - Debris	S5300	Combustible Debris	Plutonium processing operations	Acceptable Knowledge	D001	Ignitable	NA[d]	
					D002	Corrosive	NA[d]	
					D003	Reactive	NA[d]	
					D004	Arsenic	5.0	
					D005	Barium hydroxide	100.0	
	S5400	Heterogeneous Debris	Plutonium processing operations; D&D	Acceptable Knowledge	D006	Cadmium	1.0	
					D007	Chromium	5.0	
					D008	Lead	5.0	
					D009	Mercury	0.2	
					D010	Selenium	1.0	
					D011	Silver	5.0	
					D018	Benzene	0.5	
					D019	Carbon tetrachloride	0.5	
					D021	Chlorobenzene	100.0	
					D022	Chloroform	6.0	
					D035	Methyl ethyl ketone	200.0	
					D038	Pyridine	5.0[e]	
					D039	Tetrachloroethylene	0.7	
					D040	Trichloroethylene	0.5	
					D043	Vinyl Chloride	0.2	
					F001	Spent halogenated solvents	NA[d]	
					F002	Spent halogenated solvents	NA[d]	
					F003	Spent non-halogenated solvents	NA[d]	
					F004	Spent non-halogenated solvents	NA[d]	
					F005	Spent non-halogenated solvents	NA[d]	
					U080	Methylene Chloride	NA[d]	

[a] This table is based on information from the *Acceptable Knowledge Information Summary for Los Alamos National Laboratory Transuranic Waste Streams (*AKIS), (TWCP-AK-2.1, 1-019, R.0)(LA-UR-03-4870); and from waste characterization documentation information maintained by the Facility and Waste Operations Division. Waste with EPA Hazardous Waste Numbers that are not included in the Waste Isolation Pilot Plant (WIPP) Hazardous Waste Facility Permit will not be transported to WIPP. Additionally, recharacterization efforts for nitrate salt-bearing waste have been conducted and documented in several documents as outlined in Enclosure 3 of *Response to Ordered Action 2/3; Attachment A to Settlement Agreement and Stipulated Final Order HWB-14-20; Los Alamos National Laboratory.*

[b] A solid waste exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, Test Method 1331 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA, 1986), the extract from a representative sample of solid waste contains any of the contaminants listed at a concentration equal to or greater than the respective value given in the New Mexico Administrative Code , Title 20, Chapter 4, Part 1, Subpart II, Part 261, Subpart C[6-14-00].

[c] Potential underlying hazardous constituents (UHC) have been included, where the information is available. UHC characterization for the purpose of Land Disposal Restrictions will apply for mixed transuranic waste to be disposed of at WIPP.

[d] Not Applicable: Refers to the absence of regulatory limits for ignitable, corrosive and reactive characteristic waste and F-, P-, and U-listed wastes.

[e] Potential EPA Hazardous Waste Numbers only present at TA-54-0231 and TA-54-0412.

[f] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

ATTACHMENT E

INSPECTION PLAN

TA-54
ATTACHMENT E
INSPECTION PLAN

This Attachment Section presents additional inspection requirements specific to the container storage units at Technical Area (TA) 54. The Permittees shall conduct inspections at the frequency specified in the general inspection Section to identify problems in time to correct them before they harm human health or the environment.

E.1 INSPECTION REQUIREMENTS FOR TRUPACT-II CONTAINERS

The Permittees shall visually inspect waste containers prior to their placement in the TRUPACT-II containers to ensure their integrity. The inspection shall include a close examination of the cover and closure devices for visible cracks, holes, gaps, or other open spaces into the interior of the waste container when the cover and closure devices are secured in the closed position. The TRUPACT-II shall be loaded with waste containers and sealed with a locking-ring closure mechanism. After the TRUPACT-II has been sealed, the Permittees shall inspect the outside of the TRUPACT-II to ensure its integrity and that there has been no human intervention.

E.2 INSPECTION REQUIREMENTS FOR TA-54 DOME 215 HOLDING TANK

The 10,000 gallon holding tank is located at Area L, Dome 215. The tanks is used to collect liquid that may result from fire-suppression activities and that is in excess of the capacity inside the rind wall located around the dome to prevent run-on into the dome. The Permittees shall inspect the storage tank for any detectable fluids each month. If any fluids are detected in the holding tank, the Waste Management Coordinator and the Shift Operations Manager to ensure that a chemical analysis of the fluid is performed and fluid is removed within 3 days. The following inspection requirements should be applied to the monthly inspections conducted on the 10,000 gallon holding tank and shall be documented on separate forms.

E.3 STABILIZATION UNITS

The Permittees shall inspect the stabilization units located at TA-54-0231 and TA-54-0412~~,~~ according to the schedule provided below.

E.3.1 Daily (During Operation)

The Permittees shall inspect the stabilization unit each operating day (*i.e.,* when mixed waste is treated in the unit). In the daily inspection of the stabilization unit, the Permittees shall inspect the following items, as applicable:

1. Work surfaces and floors
2. Secondary containment structures
3. Labels
4. Structural integrity of stabilization unit
5. (Un)loading area

ATTACHMENT G.6
TECHNICAL AREA 54, AREA G, PAD 1
OUTDOOR CONTAINER STORAGE AND TREATMENT UNIT
CLOSURE PLAN

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1.0 INTRODUCTION

This closure plan describes the activities necessary to close the outdoor hazardous waste container storage unit and the Building 412 treatment unit at Technical Area (TA)-54, Area G, Pad 1 at the Los Alamos National Laboratory (Facility), hereinafter referred to as the permitted unit. The information provided in this closure plan addresses the closure requirements specified in Permit Part 9 and the Code of Federal Regulations (CFR), Title 40, Part 264, Subparts G and I for hazardous waste management units operated at the Facility under the Resource Conservation and Recovery Act (RCRA) and the New Mexico Hazardous Waste Act.

Until closure is complete and has been certified in accordance with Permit Section 9.5, a copy of the approved closure plan or the hazardous waste facility permit containing the plan, any approved revisions to the plan, and closure activity documentation associated with the closure will be on file with hazardous waste compliance personnel at the Facility and at the U.S. Department of Energy (DOE) Los Alamos Site Office. Prior to closure of the permitted unit, this closure plan may be amended in accordance with Permit Section 9.4.8 to provide updated sampling and analysis plans and to incorporate updated decontamination technologies. Amended closure plans shall be submitted to the New Mexico Environment Department (Department) for approval prior to implementing closure activities.

2.0 DESCRIPTION OF UNIT TO BE CLOSED

Specific descriptions of the permitted units can be found in Permit Attachment A (*Technical Area Unit Descriptions*). This section of the closure plan provides a description of the permitted units which ~~is~~ are located in the north-eastern portion of Area G and ~~is~~ are comprised of an asphalt pad with the structure (Building 412, the Decontamination and Volume Reduction System (DVRS)) situated on it.

The irregularly-shaped asphalt pad is approximately 358 feet (ft) long and 213 ft wide or approximately 76,000 square feet. The pad, which is sloped 1% to 1.5% to the south and south-east for drainage, consists of a four to six inch (in) layer of asphalt over the underlying base course overlying fill (minimum six inches of tuff). The pad has one structure associated with it, Building 412 (DVRS). Storage of mixed waste occurs on the Pad and in Building 412.

Dome 226, which was decommissioned in October 2009, was located on the eastern portion of the permitted unit. The dome was approximately 286 ft long and 89 ft wide, was built of an aluminum framework of trusses covered with tension-fitted ultraviolet resistant, fire-retardant coated, polyester fabric anchored with bolts to the pad's concrete ring wall and had a surface area of about 22,300 square ft. The interior floor perimeter of the dome was surrounded with a 6-inch-high, 6-inch-wide asphalt curb and was equipped with personnel doors and a roll-up door on the south end for vehicle access. A ramp was located at the vehicle entrance to the dome, which allowed vehicles and container handling equipment to pass safely over the interior curb which prevented run-on into the dome. At the southern end of the dome was a drain connecting to the recessed sump in Pad 9's Dome 229. This fire protection drain system consists of a 10 in. line running southeast from where Dome 226 was located with secondary connecting drains from Domes 232 and 231. The purpose of this drain system was to provide additional fire water collection capacity in the event of an emergency. The sump and drain have been plugged to prevent storm water from entering the system at the drainage point.

Building 412 is a one story building that is approximately 220 ft long by 60 ft wide or 13,200 square ft. This building is currently used for storage and volume reduction of bulky mixed waste. It consists of two structures: an internal primary confinement structure that houses mixed waste processing operations; and an external confinement building, which contains the primary confinement structure. The building itself

provides protection from the elements and a temperature-controlled space for the internal structures and associated process equipment. There are roll-up vehicle-access loading doors on the north and south ends of the building and personnel access doors on the north, east, and south for support of operations. The floor and foundation of the building are concrete and the floor is painted with an epoxy sealant. The concrete slab is above grade to direct potential run-on away from the building. The floor in the building is sloped to a sump that has a grating cover to provide traction and a level working surface.

The primary confinement structure is housed entirely within the building and consists of interconnected enclosures. The primary confinement is approximately 150 ft long by 50 ft wide by 16 ft high and sits directly on the sealed concrete floor. The primary confinement interlocks in a self supporting steel framework that can be assembled into multiple configurations. It is equipped with both large roll-up doors so that personnel, equipment, and material can access the primary confinement and move from one enclosure to the next. Equipment in the enclosures includes gloveboxes, dismantling tools (*e.g.*, power saws, hammers, pry bars), shearing and bailing equipment. Building 412 contains fire protection piping as well as heating and ventilation ducting.

The permitted treatment process within the pre-engineered containment tent within Building 412 was used to treat mixed transuranic waste (MTRU) from the S3000 (homogenous solids), S4000 (soil/gravel) and S5000 (debris) waste matrices to deactivate the RCRA hazardous waste characteristics of D001, D002, and D003. Treatment occurred under fume hoods for 55-gal. and 85-gal. drums. The fume hoods were attached to the ventilation system when in use. Permit Attachment A (*Technical Area [TA] Unit Descriptions*), Permit Attachment B (*Part A Application*), and Permit Attachment C (*Waste Analysis Plan*) include information regarding waste treatment practices and hazardous waste constituents treated at the permitted unit. The permitted storage unit has been used for the storage of both liquid and non-liquid mixed waste and has stored the following waste types: solidified inorganic solids; leached process residues; salts and cement paste; ash; dewatered aqueous sludge; chemical treatment sludge; soils; combustible debris (*e.g.*, plastics, rubber, laboratory trash, building debris); and heterogeneous debris.

Permit Part 3 (*Storage in Containers*), Permit Attachment A (*Technical Area Unit Descriptions*), Permit Attachment B (*Part A Application*), and Permit Attachment C (*Waste Analysis Plan*) include information about hazardous waste management procedures and hazardous waste constituents stored at the permitted unit.

A total of 16 transportainers and storage sheds, which are used for the storage of tools and equipment are also located on the permitted unit. These structures are situated on the permitted unit as support structures and, according to the Facility Operating Record, they have not been used to store hazardous waste.

3.0 ESTIMATE OF MAXIMUM WASTE STORED AND TREATED

Approximately 1,458,500 gallons of hazardous waste has been stored at the permitted unit to date. Throughout the life of this Permit, it is estimated that an additional 1,760,000 gallons of hazardous waste will be stored. It is estimated that approximately 99,000 gal. of hazardous waste will be treated and repackaged at Building 412 over its active life.

Table G.6-1

Closure Schedule for the Technical Area 54, Area G, Pad 1 Outdoor Container Storage/Treatment Unit

Activity	Maximum Time Required
Notify the Department of intent to close.	-45 days
Final receipt of waste.	Day 0
Complete waste removal.	Day 90
Complete records review and structural assessment.	10 days after completed waste removal or 100 days after final receipt of waste
Complete all closure activities and submit final closure certification report to the Department.	Day 180

Table G.6-6

List of Equipment at the Technical Area 54, Area G, Pad 1 Outdoor Container Storage/Treatment Unit

Equipment	Decontamination	Disposal
Drum venting and associated equipment	X	
Electrical infrastructure	X	X
Equipment and spill cleanup equipment containers	X	
Air pallets	X	
Container pallets	X	X
Communication equipment	X	X
Access barriers and chains	X	X
Gloveboxes	X	X
Portable air monitors	X	X
Enclosure components	X	X
Electronic devices or tools	X	
Cabinets	X	
Bailing equipment	X	

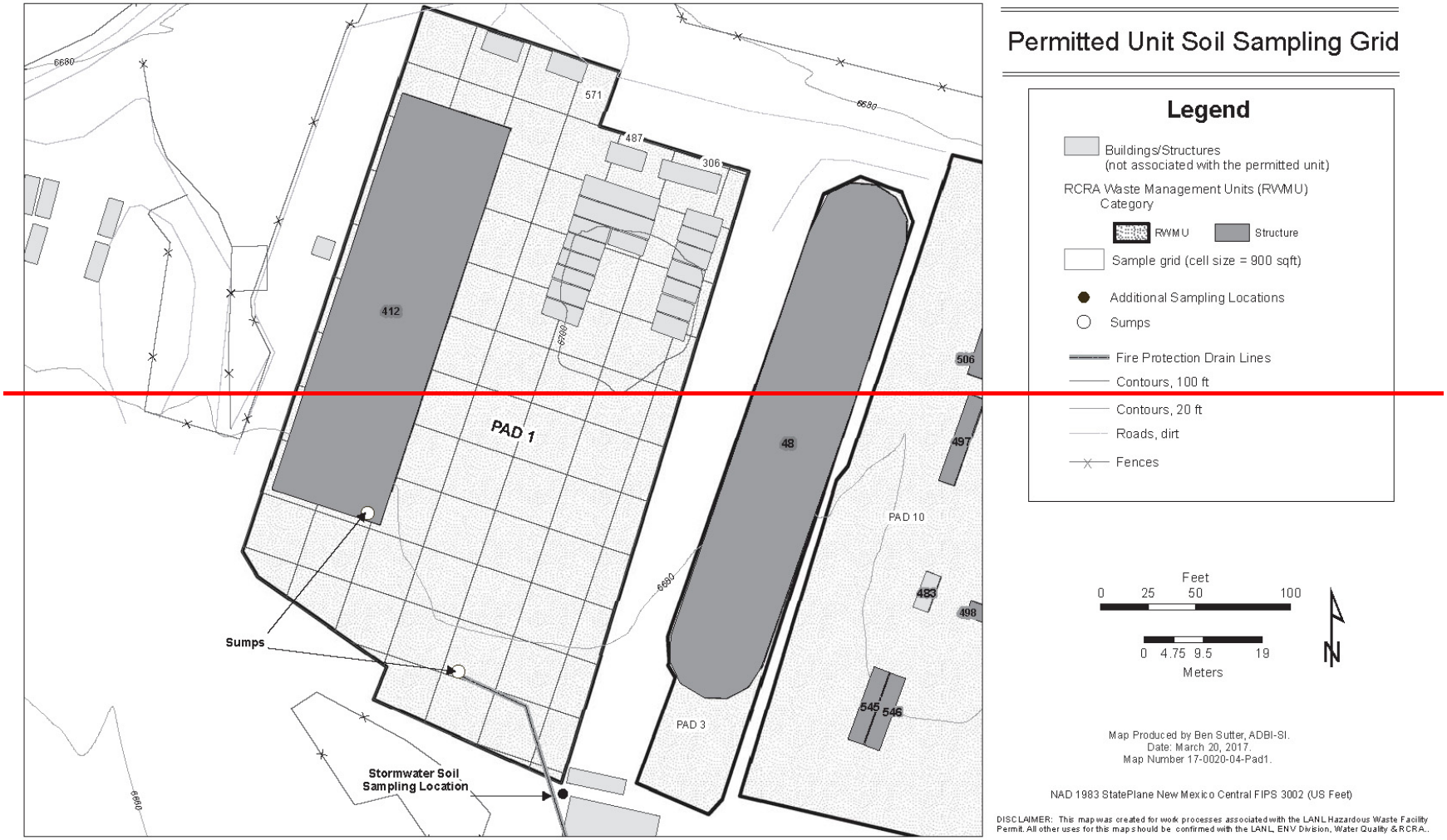


Figure G.6-1: Technical Area 54, Area G, Pad 1 Outdoor Container Storage Unit Grid Sampling Locations

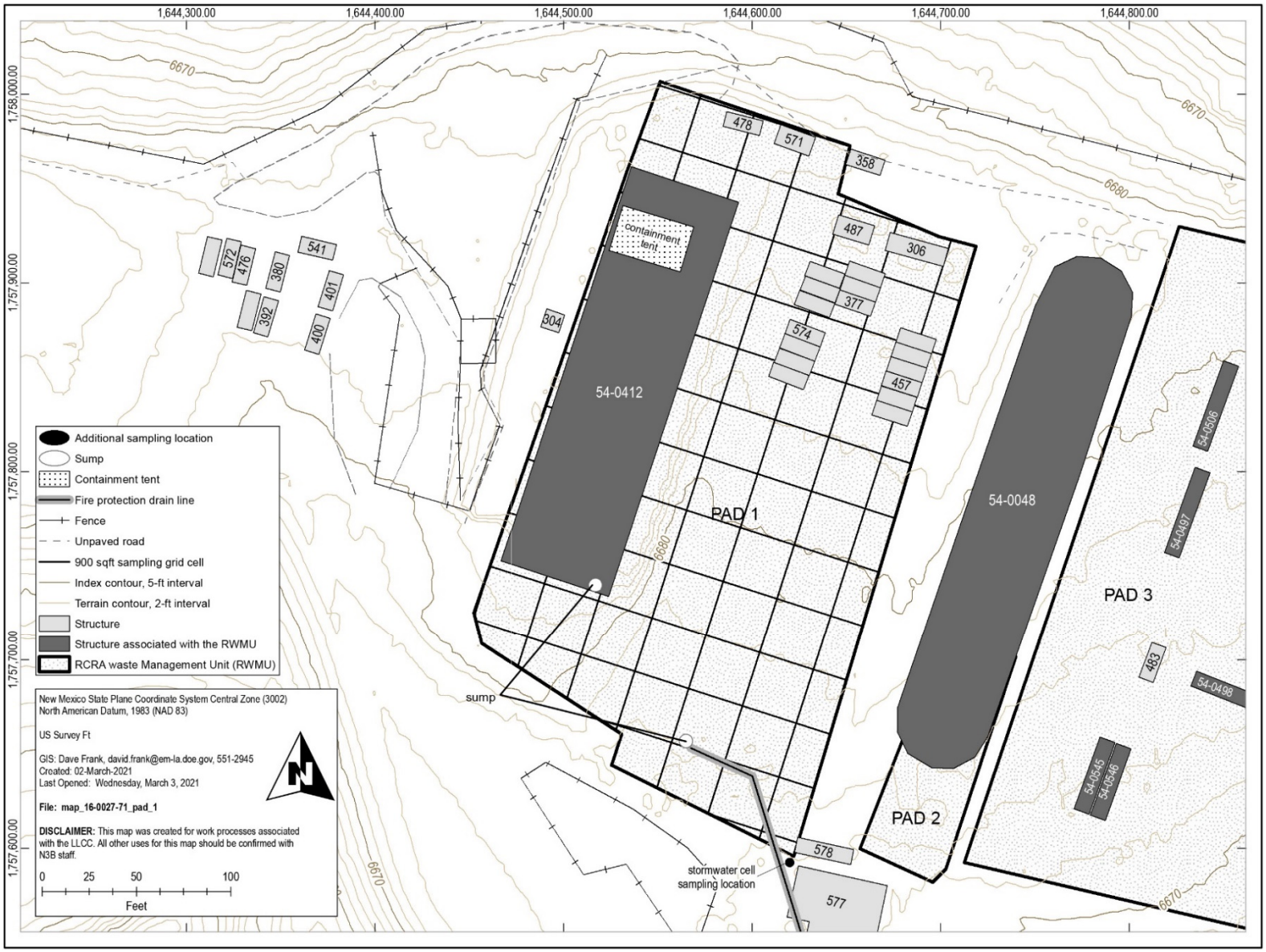


Figure G.6-1: Technical Area 54, Area G, Pad 1 Outdoor Container Storage/Treatment Unit Grid Sampling Locations

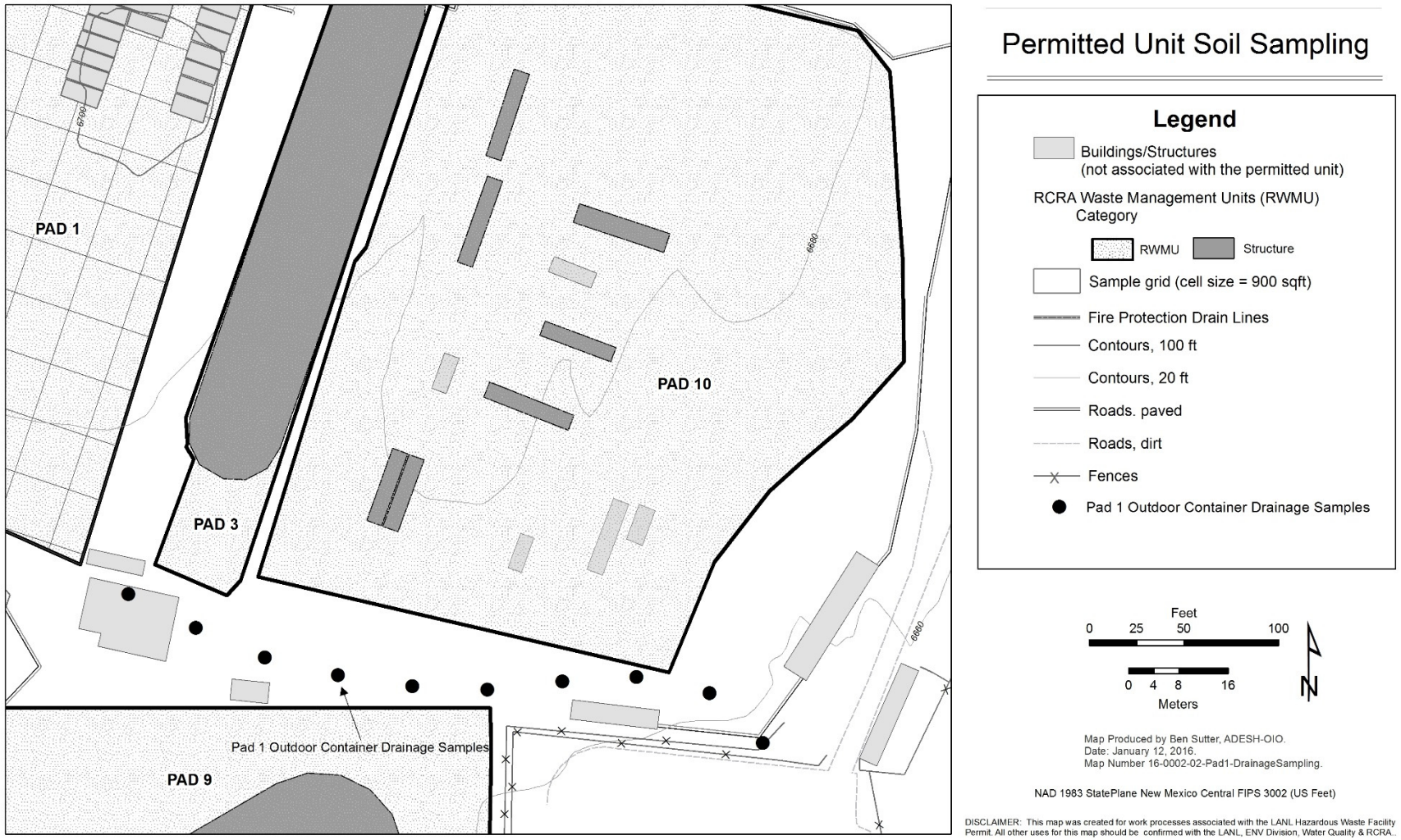


Figure G.6-2: Technical Area 54, Area G, Pad 1 Outdoor Container Storage/Treatment Unit Drainage Sampling

ATTACHMENT J

HAZARDOUS WASTE MANAGEMENT UNITS

Unit Identifier	Process Codes	Operating Capacity	General Information	Type of Unit
TA-54 "G"	D80	NA	Material Disposal Area Unit not permitted to receive hazardous waste	Regulated unit
TA-54 Area G Container Storage Unit (below ground)	S99	4,950 gal	Includes shafts 145 and 146 Wastes removed and unit undergoing closure, closure certification incomplete	NA
TA-54 Area G Pad 1	S01 T04	502,920 gal 23,160 gal/day	Includes building TA-54-412 (DVRS) Includes treatment process for macroencapsulation, stabilization (including absorption), and neutralization Approximately 76,000 square feet	Outdoor (associated with a regulated unit)
TA-54 Area G Pad 3	S01	213,840 gal 23,160 gal/day	Includes Storage Dome 48 Includes treatment process for macroencapsulation Approximately 17,000 square feet	Outdoor (associated with a regulated unit)
TA-54 Area G Pad 5	S01 T04	623,480 gal 23,160 gal/day	Includes Storage Domes 49 and 224 and Storage Sheds 144, 145, 146, 177, 1027, 1028, 1030, and 1041 Pad 5 is a consolidation of former Pads 5, 7, and 8. Includes treatment process for macroencapsulation Total square footage – 59,900	Outdoor (associated with a regulated unit)
TA-54 Area G Pad 6	S01	597,300 gal	Includes Storage Domes 153 and 283; and Transportainer 491.	Outdoor (associated with

Appendix B

Replacement Figures for Hazardous Waste Facility Permit, Attachment G.6, Figure G.6-1, and Attachment N, Figures 27 and 29

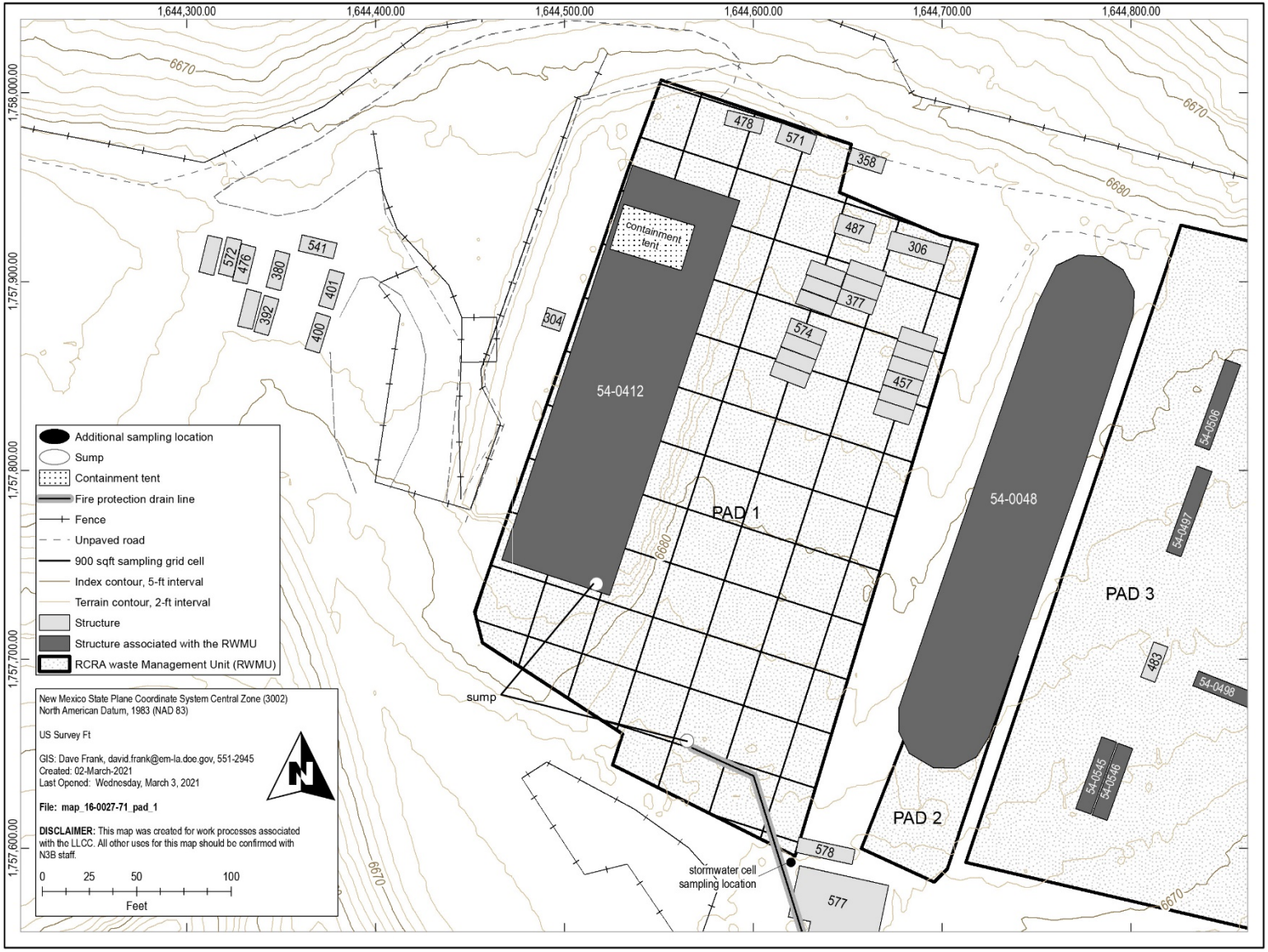


Figure G.6-1: Technical Area 54, Area G, Pad 1 Outdoor Container Storage/Treatment Unit Grid Sampling Locations

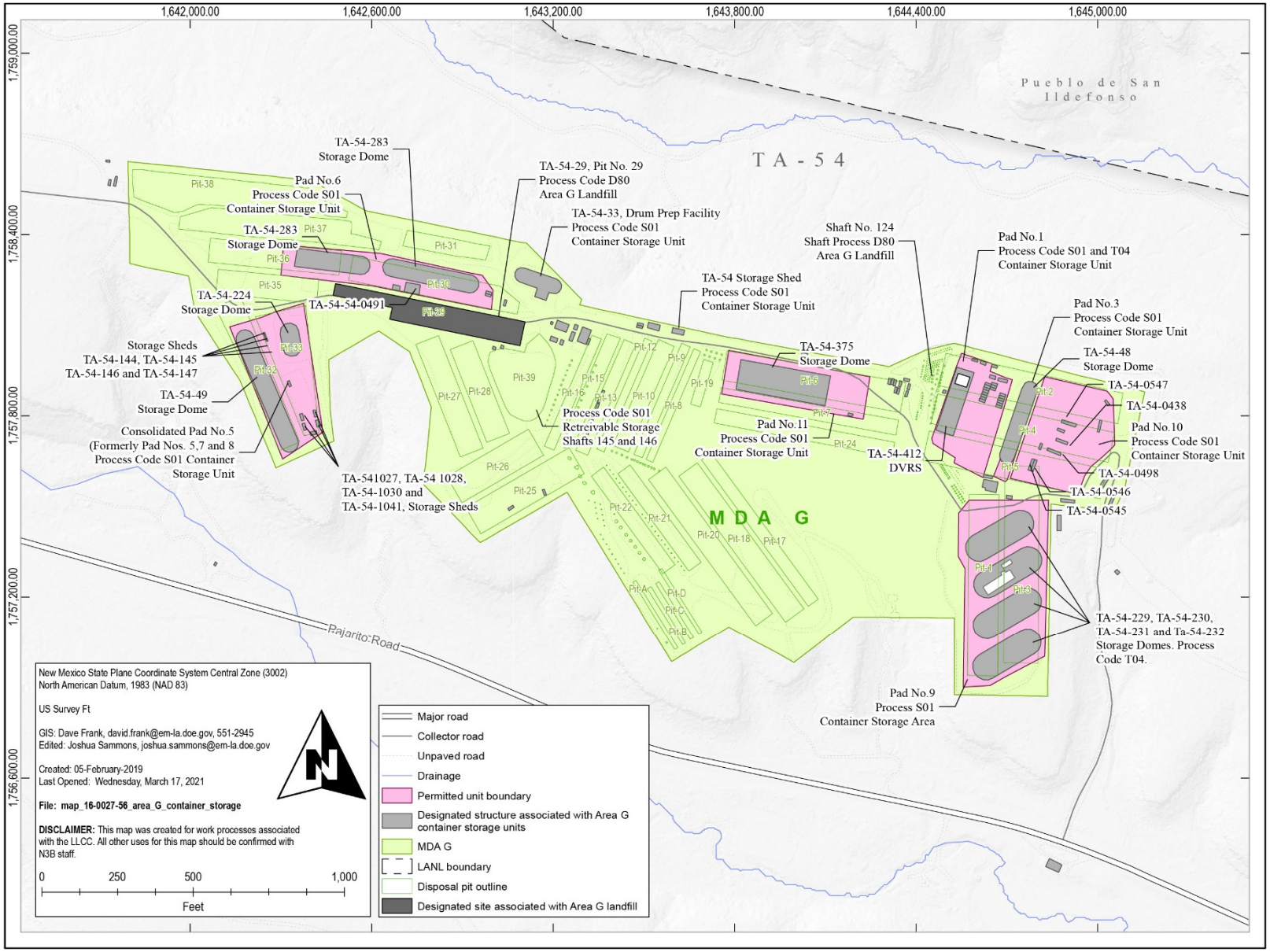


Figure 27: Technical Area 54, Area G, Container Storage/Treatment Units

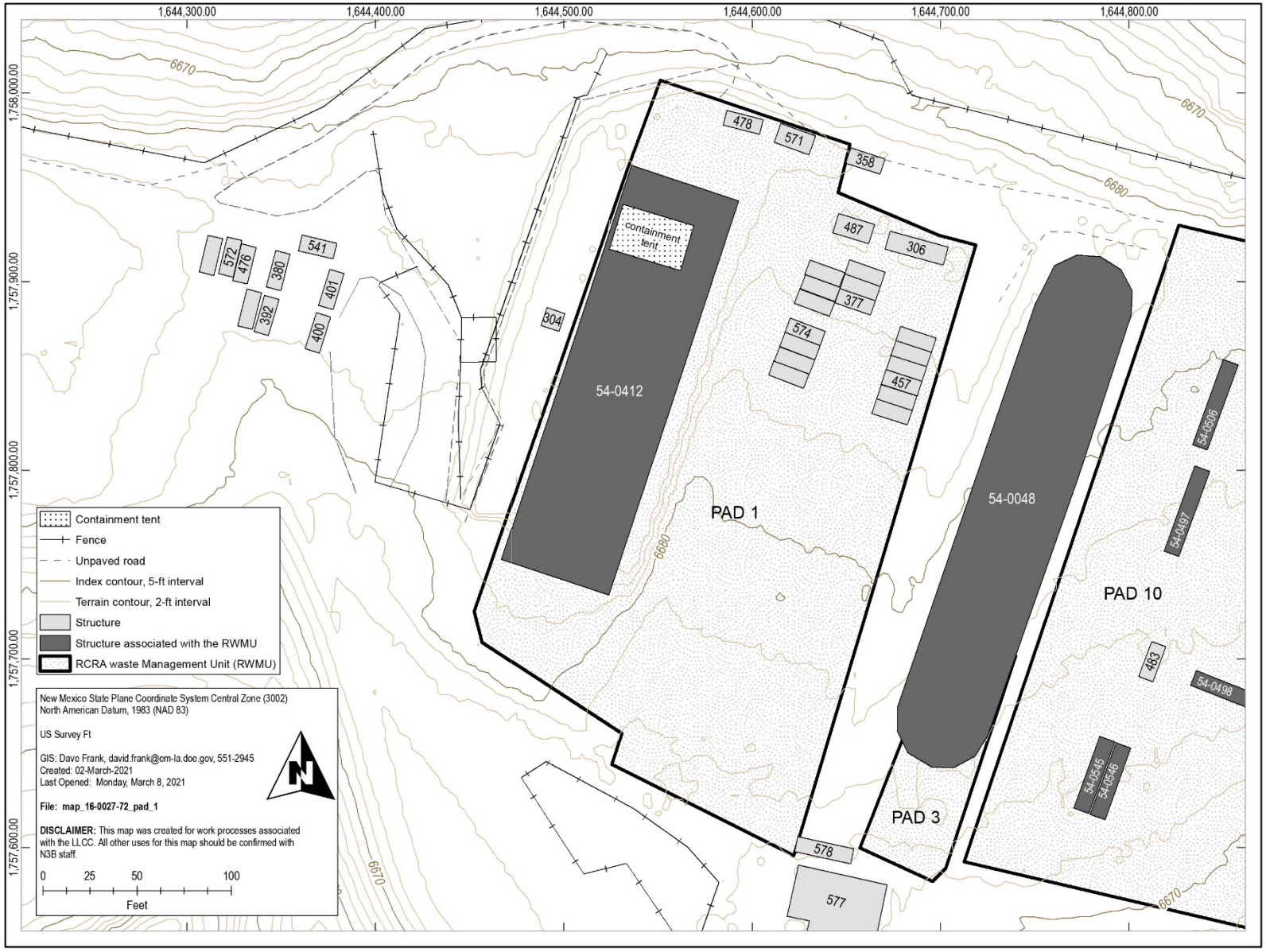


Figure 29: TA-54, Area G, Pad 1

Appendix C

Hanna Instruments Letter Certification

Hanna Instruments United States Inc.
270 George Washington Hwy. Smithfield, RI, 02917
Tel: 401-765-0045
www.hannainst.com

December 16, 2020

To Whom It May Concern,

The purpose of this document is to certify that the following Hanna Instruments Products

HI98190 Professional Waterproof Portable pH/ORP Meter

meets all required specifications for operation in compliance with

EPA Method HI904C, Revision 3, November 2004, "pH Electrometric Measurement."

In accordance with this certification, Hanna's product meets compliancy critera when used per the operational guidelines outlined in the methodology.

Warm Regards,

Michelle Salisbury

APPLICATIONS MANAGER, HANNA USA

Appendix D

Manual for HI98190 Professional
Waterproof Portable pH/ORP Meter

HI98190, HI98191

Calibration Check Waterproof pH/mV/ISE/Temperature Meters

INSTRUCTION MANUAL

HANNA® instruments

Dear Customer,

Thank you for choosing a Hanna Instruments product.

Please read this instruction manual carefully before using the instrument.

This manual will provide you with the necessary information for correct use of the instrument, as well as a precise idea of its versatility.

If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com or view our worldwide contact list at www.hannainst.com.

TABLE OF CONTENTS

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any damage, please contact your local Hanna Instruments Office.

Each instrument is supplied with:

- HI12963 Amplified Combined pH temperature electrode (HI98190)
- HI72911B Combined pH temperature electrode (HI98191)
- HI7662 Temperature Probe (HI98191)
- pH 4.01 & 7.01 Buffer Solutions (230 mL each)
- HI700601 General Purpose Cleaning Solution (3 pcs.)
- 100 mL Plastic Beaker (2 pcs.)
- 1.5V AA Batteries (4 pcs.)
- HI920015 Micro USB cable
- Instruction Manual and Quick Reference Guide
- Certificate

Note: Save all packing material until you are sure that the instrument functions correctly. All defective items must be returned in the original packing with the supplied accessories.

The HI98190 and HI98191 instruments are state-of-the-art, heavy-duty pH meters, designed to provide laboratory results and accuracy under harsh industrial conditions.
They are provided with a series of new diagnostic features which add an entirely new dimension to the measurement of pH, by allowing the user to dramatically improve the reliability of the measurement:

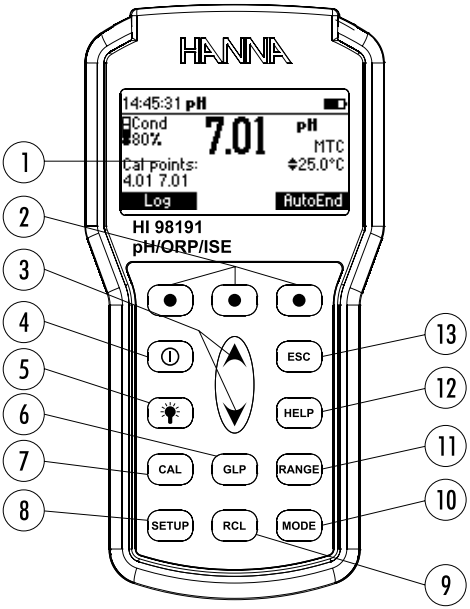
- seven standard buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) for calibration.
- pH calibration up to five calibration points (see instrument specifications).
- Custom calibration with up to five custom buffers.
- Messages on the graphic LCD for an easy and accurate calibration.
- Cal Check™ Diagnostic features to alert the user when the electrode needs cleaning.
- Optional user enabled "Outside Calibration Range" warning.
- Monitoring of the electrode aging.
- User selectable "Calibration Time Out" to remind when a new calibration is necessary.

Moreover, they offer an extended temperature range from -20 to 120 °C (-4 to 248 °F), using a temperature sensor inside pH electrode.
These instruments can also measure with ORP electrodes, thanks to their capability to measure mV with a resolution up to 0.1 mV.
HI98191 can also measure with ISE electrodes. The electrode type unit selection capability and the ISE calibration in up to five calibration standard solutions make this instrument very useful for a large range of concentration solutions measurements.

Other features include:

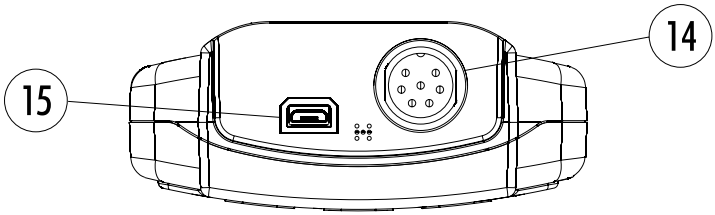
- Relative mV measurements
- Log on demand up to 300 samples for HI98191 and 200 samples for HI98190 (100 samples on each range - pH, mV, ISE only HI98191)
- Auto Hold feature, to freeze first stable reading on the LCD
- GLP feature, to view last calibration data for pH, Rel mV, or ISE
- PC interface

FRONT VIEW



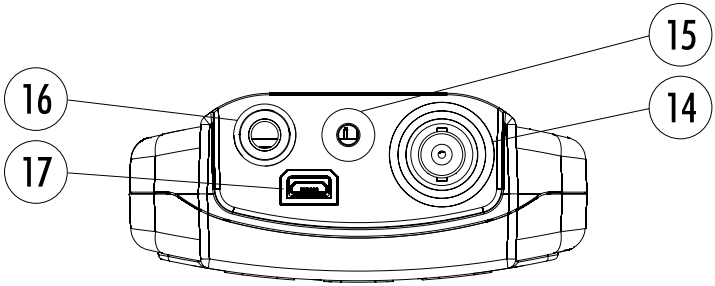
1) Liquid Crystal Display (LCD).
2) Functional keys.
3) ▲/▼ keys to manually increase/decrease the parameters or to scroll between the parameter list.
4) **ON/OFF (ⓘ)** key, to turn the instrument ON and OFF.
5) **LIGHT (☀)** key to toggle display backlighting.
6) **GLP** key, to display Good Laboratory Practice information.
7) **CAL** key, to enter/exit calibration mode.
8) **SETUP** key, to enter/exit SETUP mode.
9) **RCL** key, to enter/exit view logged data mode.
10) **MODE** key to change pH resolution or to toggle between mV and Rel mV mode.
11) **RANGE** key, to switch between pH and mV range (HI98190) or pH, mV and ISE range (HI98191).
12) **HELP** key to enter/exit contextual help.
13) **ESC** to leave current mode, exit calibration, setup, help. etc.

TOP VIEW HI98190



14) Electrode **DIN** connector.
15) USB connector.

TOP VIEW HI98191



14) BNC electrode connector.
15) Input for Reference electrode.
16) Input for Temperature probe.
17) USB Connector.

pH	Range	-2.0 to 20.0 pH / -2.00 to 20.00 pH / -2.000 to 20.000 pH
	Resolution	0.1 pH / 0.01 pH / 0.001 pH
	Accuracy	±0.1 pH / ±0.01 pH / ±0.002 pH
mV	Range	±2000 mV
	Resolution	0.1 mV
	Accuracy	±0.2 mV
Temperature	Range	-20.0 to 120.0 °C (-4.0 to 248.0 °F)
	Resolution	0.1 °C (0.1 °F)
	Accuracy	±0.4 °C (±0.8 °F) (excluding probe error)
Rel mV Offset Calibration		±2000 mV
pH Calibration		Up to five point calibration, seven standard buffers available (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and five custom buffers
Slope Calibration		From 80 to 110%
Temperature Compensation		Manual or Automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode		HI12963 pH & temperature
LOG		On demand, 200 samples (100 samples on each range)
Input Impedance		10^{12} Ω
Battery Type/Life		1.5V AA batteries (4 pcs.) / approx. 200 hours of continuous use without backlight (50 hours with backlight)
Auto Power Off		User selectable: 5, 10, 30, 60 minutes or disabled
PC Interface		opto-isolated USB
Dimensions		185 x 93 x 35.2 mm (7.3 x 3.6 x 1.4")
Weight		400 g (14.2 oz)
Environment		0 to 50 °C (32 to 122 °F) max. RH 100% IP67

pH	Range	-2.0 to 20.0 pH / -2.00 to 20.00 pH / -2.000 to 20.000 pH
	Resolution	0.1 pH / 0.01 pH / 0.001 pH
	Accuracy	±0.1 pH / ±0.01 pH / ±0.002 pH
mV	Range	±2000 mV
	Resolution	0.1 mV
	Accuracy	±0.2 mV
ISE	Range	From 1.00 E^{-7} to 9.99 E^{10} concentration
	Resolution	3 digits 0.01, 0.1, 1, 10 concentration
	Accuracy	±0.5% of reading (monovalent ions) ±1% of reading (divalent ions)
Temperature		-20.0 to 120.0 °C (-4.0 to 248.0 °F)
Rel mV Offset Range		±2000 mV
pH Calibration		Up to five point calibration, seven standard buffers available (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and five custom buffers
Slope Calibration		From 80 to 110%
ISE Calibration		Up to five point calibration points six standard solutions available (0.1, 1, 10, 100, 1000, 10000 ppm)
Temperature Compensation		Manual or Automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode		HI72911B pH & temperature (included)
LOG		On demand, 300 samples (log samples on each range)
Input Impedance		10^{12} Ω
Battery Type/Life		1.5V AA batteries (4 pcs.) / approx. 200 hours of continuous use without backlight (50 hours with backlight)
Auto Power Off		User selectable: 5, 10, 30, 60 minutes or disabled
PC Interface		opto-isolated USB
Dimensions		185 x 93 x 35.2 mm (7.3 x 3.6 x 1.4")
Weight		400 g (14.2 oz)
Environment		0 to 50 °C (32 to 122 °F) max. RH 100% IP67

INITIAL PREPARATION

The instrument is supplied complete with 1.5V AA (4 pcs.) batteries. For placing the batteries inside the meter, see page 54.

To prepare the instrument for field measurements close the serial communication socket and all unused connector sockets with proper stopper (to ensure waterproof protection). Use the holed temperature rubber cork for the temperature socket when temperature probe is connected.

For HI98191 connect the pH electrode and the temperature probe to the BNC and temperature sockets on the top of the instrument. Push the pH electrode sleeve to cover the connector accommodation.

The temperature probe is used in conjunction with the pH electrode to utilize the instrument's ATC capability, but it can also be used independently to take temperature measurements. If the probe is disconnected, temperature can be set manually with the ▲/▼ keys.

For HI98190 connect the pH/temperature electrode to the DIN connector.

Turn the instrument ON by pressing **ON/OFF** key.

At start-up the display will show the Hanna Instruments logo for a few seconds followed by the percentage indication of the remaining battery life, then enters the measurement mode.

After measurement switch the instrument off, clean the electrode and store it with a few drops of HI70300 storage solution in the protective cap (see page 57).

The Auto Power Off feature turns the instrument off after a set period (default 30 min) with no button pressed to save battery life. To set another period or to disable this feature, see **SETUP** menu on page 31.

The Auto Light Off backlight feature turns the backlight off after a set period (default 1 min) with no buttons pressed. To set another period or to disable this feature, see **SETUP** menu on page 31.

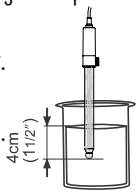
pH MEASUREMENTS

To take a pH measurement remove the electrode protective cap and simply submerge the tip of the electrode (4 cm/1½") into the sample to be tested.

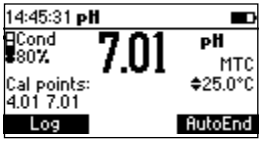
Press **RANGE** key until the display changes to the pH range, if necessary.

Use **MODE** key to select the pH resolution.

Allow for the electrode to adjust and reading to stabilize (hourglass symbol turns off).



On the pH screen are displayed:



- pH reading with the selected resolution.
- Temperature reading in the selected unit (°C or °F).
- Temperature compensation mode (MTC - manual, ATC - automatic). While in MTC mode the ▲▼ indicate that the temperature can be manually changed using ▲/▼ keys.
- Electrode condition during the calibration day.
- The buffers used in last pH calibration (if feature is enabled in **SETUP**).
- Battery level indicator.
- Available functional keys in accordance with the model.

In order to take more accurate pH measurements, make sure that the instrument is calibrated (see page 14 for calibration details).
It is recommended that the electrode is always kept moist and rinsed thoroughly with the sample to be measured before use.
The pH reading is directly affected by temperature. For accurate pH measurements, temperature must be taken into consideration. If the sample temperature is different from the temperature at which the pH electrode was kept, allow a few minutes to reach thermal equilibrium.
To use the instrument's Automatic Temperature Compensation (ATC) feature, submerge the temperature probe into the sample as close to the electrode as possible and wait for a few seconds.

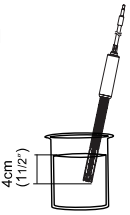
If manual temperature compensation (MTC) is desired, the temperature probe must be disconnected from the instrument (HI98191 only).

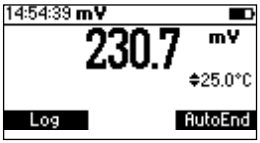
The display will show the default temperature of 25 °C, the last measured temperature reading, or the last set temperature, with the **"MTC"** indication.
The **"MTC"** indication and the ▲▼ symbol light up on the LCD to indicate that the instrument is in MTC mode and the ▲/▼ keys can be used to enter the desired temperature value.

Note: When in MTC the user can press and hold the ▲/▼ keys, and the instrument will start incrementing /decrementing the temperature value. The instrument keeps measuring and the display is updated periodically.

ORP MEASUREMENTS

To perform ORP measurements, connect an optional ORP electrode to the instrument and turn it ON.
Press **RANGE** key until mV range is displayed, if necessary.
Submerge the ORP electrode tip (4 cm/1½") into the sample to be tested and wait a few seconds for the reading to stabilize.
Measurements are displayed with 0.1 mV resolution.

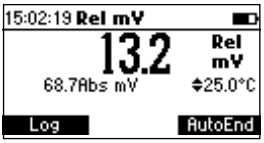




The "**ATC**" (or "**MTC**") message is turned off because mV readings are not temperature compensated.
For accurate ORP measurements, the surface of the electrode must be clean and smooth. Pretreatment solutions are available to condition the electrode and improve its response time.

RELATIVE mV MEASUREMENTS

To enter Relative mV mode, press **MODE** while in mV measurement mode. The relative mV reading will be displayed along with the Absolute mV value and the current temperature readings.
The relative mV reading is equal to the difference between the absolute mV input value and relative mV offset established in the relative mV calibration.

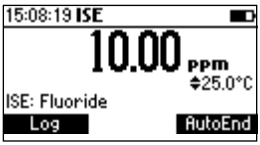


Note: If using the pH electrode while in mV mode, the instrument will measure the mV generated by the pH electrode.

ISE MEASUREMENTS (HI98191 only)

To perform ion concentration measurements, connect an optional ISE electrode and the corresponding reference (if necessary) to the instrument and turn it ON.
Enter the ISE mode by pressing **RANGE** until the display changes to ISE range.
Submerge the ISE electrode tip (4 cm/1½") into the sample to be tested and wait a few seconds for the reading to stabilize.

The ISE reading will be displayed along with the current temperature reading.



The **"ATC"** (or **"MTC"**) message is turned off because ppm readings are not temperature compensated.
In order to take accurate ISE measurements, make sure that the appropriate ISE electrode type and ISE unit were set in **SETUP** menu and the instrument was calibrated (see ISE CALIBRATION for details, page 25).

Notes: When the reading is out of range, the display will flash the closest full-scale value. The instrument will display "----" on the primary LCD if it is not calibrated. Perform at least a one point calibration in order to take ISE measurements.
Changing the ISE electrode or the ion charge will need ISE range calibration.

TEMPERATURE MEASUREMENTS

For HI98190 the temperature sensor is connected through DIN socket.
Connect the temperature connector to the appropriate socket (HI98191). Immerse the pH electrode into the sample and allow the reading on the secondary LCD to stabilize.

Note: The temperature can be displayed in Celsius degrees (°C) or in Fahrenheit degrees (°F) (see SETUP for details, page 31).

BACKLIGHT FEATURE

The instrument is provided with a Backlight feature, which can be easily toggled on and off through the keyboard by pressing **LIGHT**.

Note: The backlight automatically shuts off after a set period (see SETUP for details, page 31) with no buttons pressed.

It is recommended to calibrate the instrument frequently, especially if high accuracy is required.
The pH range should be recalibrated:

- Whenever the pH electrode is replaced.
- At least once a week.
- After testing aggressive chemicals.
- When calibration alarm time out is expired - **"CAL DUE"** blinks (if feature is enabled in **SETUP**).
- If **"Outside Cal Range"** message blinks during pH measurement (the measurement range is not covered by current calibration, if feature is enabled in **SETUP**).

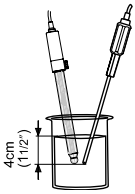
PROCEDURE

HI98190 and HI98191 instruments offers a choice of seven standard buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45). The meters allow the user to set up to five custom buffers. The set custom buffers are the buffer values at 25 °C.
When a custom buffer is selected during calibration, the **Custom** functional key is displayed on the LCD. Press **Custom** key in order to enter custom buffer changing mode. Use ▲/▼ keys to change the value in a ±1.00 pH window, in according with the temperature reading and then **Accept**. Press **ESC** to leave custom buffers value unchanged.
For accurate pH measurements, it is recommended to perform a calibration in maximum allowed points. However, at least a two point calibration is suggested.
The instrument will automatically skip the buffers used during calibration and the buffers which are in a ±0.2 pH window around one of the calibrated buffers.

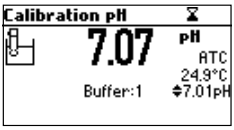
- Pour small quantities of selected buffer solutions into clean beakers. For accurate calibration use two beakers for each buffer solution, the first one for rinsing the electrode and the second one for calibration.
- Remove the protective cap and rinse the electrode with some of the buffer solution to be used for the first calibration point.

FIVE POINT CALIBRATION

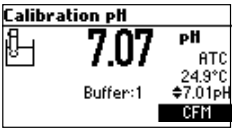
- Immerse the pH electrode approximately 4 cm (1½") into a buffer solution of your choice (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45 or a custom buffer) and stir gently. The temperature probe (HI98191 only) should be close to the pH electrode.



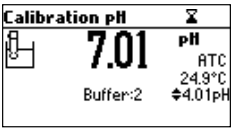
- Press **CAL**. The instrument will display the measured pH, the LCD first expected buffer and the temperature reading.



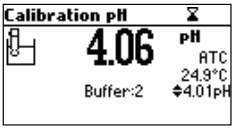
- If necessary, press the ▲/▼ keys to select a different buffer value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected buffer, **CFM** functional key is displayed.



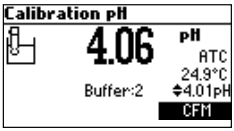
- Press **CFM** to confirm first point.
- The calibrated value and the second expected buffer value is then displayed on the LCD.



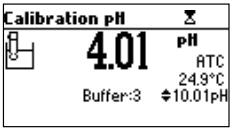
- After the first calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the second buffer solution and stir gently. The temperature probe should be close to the pH electrode.
- If necessary, press the ▲/▼ keys to select a different buffer value.
- The "⧖" tag will blink on the LCD until the reading is stable.



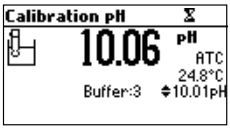
- When the reading is stable and within range of the selected buffer, the **CFM** functional key is displayed.



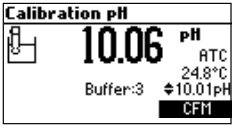
- Press **CFM** to confirm calibration.
- The calibrated value and the third expected buffer value will be displayed.



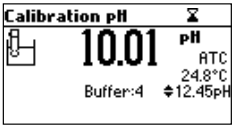
- After the second calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the third buffer solution and stir gently. The temperature probe should be close to the pH electrode.



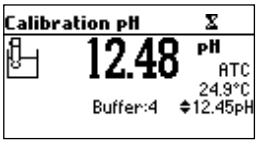
- If necessary, press the ▲/▼ keys to select a different buffer value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected buffer, the **CFM** functional key is displayed.



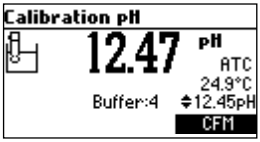
- Press **CFM** to confirm calibration.
- The calibrated value and the fourth expected value will be displayed.



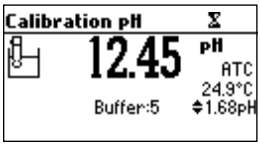
- After the third calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the fourth buffer solution and stir gently. The temperature probe should be close to the pH electrode.
- If necessary, press the ▲/▼ keys to select a different buffer value.
- The "⧖" tag will blink on the LCD until the reading is stable.



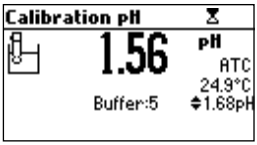
- When the reading is stable and within range of the selected buffer, the **CFM** functional key is displayed.



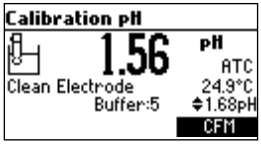
- Press **CFM** to confirm calibration.



- The calibrated value and the fifth expected buffer will be displayed.
- After the fourth calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the fifth buffer solution and stir gently.
  The temperature probe should be close to the pH electrode.



- If necessary, press the ▲/▼ keys to select a different buffer value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected buffer, the **CFM** functional key is displayed.



- Press **CFM** to confirm calibration.
- The instrument stores the calibration values and returns to normal measurement mode.

FOUR, THREE or TWO POINT CALIBRATION

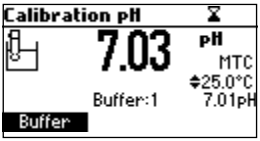
- Proceed as described in "FIVE POINT CALIBRATION" section.
- Press **CAL** or **ESC** after the appropriate accepted calibration point. The instruments will return to measurement mode and will memorize the calibration data.

ONE POINT CALIBRATION

Two **SETUP** selectable options are available for one point calibration: **Replace** and **Offset**.
If the **Replace** option is selected, the slopes between current buffer and nearest lower and higher buffers will be reevaluated.
If the **"Offset"** option is selected, an electrode offset correction is performed keeping unchanged the existing slopes.

- Proceed as described in "FIVE POINT CALIBRATION" section.
- Press **CAL** or **ESC** after the first calibration point was confirmed. The instruments will memorize the one point calibration data and will return to measurement mode.

Notes: Press MTC or MODE key to toggle between pH buffer selection and the temperature reading during calibration while temperature probe is not connected (MTC mode).

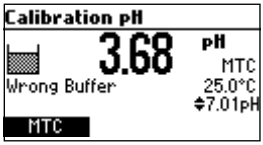


The displayed arrow is moving to the temperature value. Use ▲/▼ keys in order to change the temperature.

ERROR SCREENS

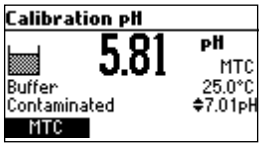
Wrong buffer

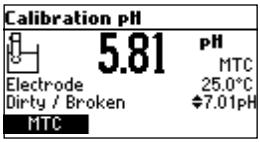
The calibration cannot be confirmed.



The pH reading is not within range of the selected buffer. Select another buffer using the ▲/▼ keys or change the buffer.

Electrode Dirty/Broken alternatively with **Buffer Contaminated**
The calibration cannot be confirmed.

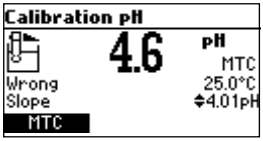




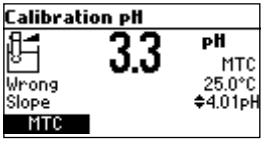
The offset of the electrode is not in the accepted range. Check if the electrode is broken or clean it following the Cleaning Procedure (see page 57). Check the quality of the buffer. If necessary, change the buffer.

Wrong slope

The calibration cannot be confirmed.



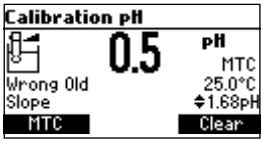
The evaluated slope is less than the lowest accepted value (80% of default slope).



The evaluated slope is more than the highest accepted value (110 % of default slope).

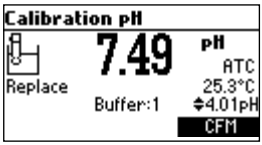
Wrong old slope

An inconsistency between new and previous (old) calibration is detected. Clear old calibration parameters and proceed with the calibration from the current point. The instrument will keep all confirmed values during current calibration.



Note: For one point calibration the electrode condition is not displayed in the measurement screen. Each time a buffer is confirmed, the new calibration parameters replace the old calibration parameters of the corresponding buffer.

If the current confirmed buffer has no correspondence in the existing stored calibration and this is not full, the current buffer is added to the existing stored calibration.
If the existing stored calibration is full (five calibration points), after confirming the calibration point, the instrument will ask which buffer will be replaced by current buffer.

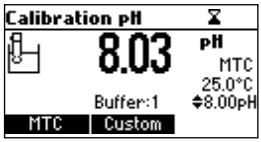


Press ▲/▼ keys to select another buffer to be replaced.
Press **CFM** to confirm the buffer that will be replaced.
Press **CAL** or **ESC** to leave replace mode. In this case, the buffer will not be memorized.

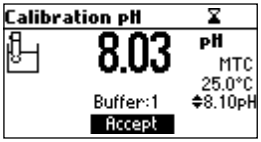
Note: The replaced buffer is not removed from calibration list and it can be selected for the next calibration points.

WORKING WITH CUSTOM BUFFERS

If at least one custom buffer was set in **SETUP** menu, it can be selected for calibration by pressing the ▲/▼ keys. The **Custom** functional key will be displayed.



Press **Custom** if you want to adjust the buffer value according with current temperature.
Use the ▲/▼ keys to change the buffer value.

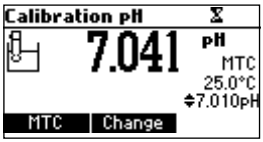


Press **Accept** to accept new value or **ESC** to exit changing mode.

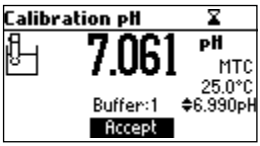
Note: Custom buffer value can be adjusted in a ±1.00 pH window, around the set value.

WORKING WITH MILI pH BUFFERS

If calibration is invoked from mili pH range, the calibration buffer can be modified in a ±0.020 pH range in according with the label on the calibration buffer.



Press **Change** to enter buffer adjust mode.

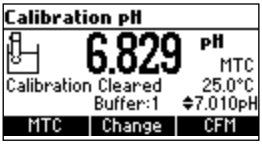


Use ▲/▼ keys to change the buffer value.
Press **Accept** to accept new value or **ESC** to exit adjusting mode.

CLEAR CALIBRATION

Press **Clear** functional key when displayed to clear old calibrations.
All old calibrations, are cleared and the instrument continues calibration. The points confirmed in current calibration are kept.

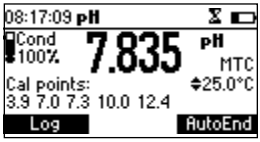
Note: If Clear calibration is invoked during the first calibration point, the instrument returns to measurement mode.



ELECTRODE CONDITION

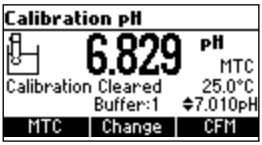
The display is provided with an icon, and a numeric value (unless the feature is disabled) which gives an indication of the electrode status after calibration.
The "condition" remains active until the end of the calibration day.

Note: The electrode condition is evaluated only if current calibration includes at least two standard buffers.



CLEAN ELECTRODE WARNING

Each time pH calibration is performed, the instrument internally compares the new calibration with the one previously stored.
When this comparison indicates a significant difference, the **"Clean Electrode"** warning message is displayed to advise the user that the pH electrode may need to be cleaned (see ELECTRODE CONDITIONING AND MAINTENANCE section for details, page 56).



After cleaning, perform a new calibration.

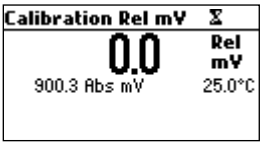
Note: If the calibration data are cleared, the comparison is done with the default values.

The temperature has an effect on pH. The calibration buffer solutions are affected by temperature changes to a lesser degree than normal solutions. During calibration the instrument will automatically calibrate to the pH value corresponding to the measured or set temperature.

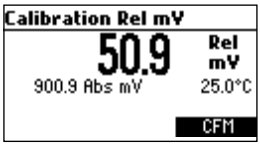
TEMP		pH BUFFERS						
°C	°F	1.68	4.01	6.86	7.01	9.18	10.01	12.45
0	32	1.67	4.01	6.98	7.13	9.46	10.32	10.38
5	41	1.67	4.00	6.95	7.10	9.39	10.25	13.18
10	50	1.67	4.00	6.92	7.07	9.33	10.18	12.99
15	59	1.67	4.00	6.90	7.05	9.27	10.12	12.80
20	68	1.68	4.00	6.88	7.03	9.22	10.06	12.62
25	77	1.68	4.01	6.86	7.01	9.18	10.01	12.45
30	86	1.68	4.02	6.85	7.00	9.14	9.96	12.29
35	95	1.69	4.03	6.84	6.99	9.11	9.92	12.13
40	104	1.69	4.04	6.84	6.98	9.07	9.88	11.98
45	113	1.70	4.05	6.83	6.98	9.04	9.85	11.83
50	122	1.71	4.06	6.83	6.98	9.01	9.82	11.70
55	131	1.72	4.08	6.84	6.98	8.99	9.79	11.57
60	140	1.72	4.09	6.84	6.98	8.97	9.77	11.44
65	149	1.73	4.11	6.84	6.99	8.95	9.76	11.32
70	158	1.74	4.12	6.85	6.99	8.93	9.75	11.21
75	167	1.76	4.14	6.86	7.00	8.91	9.74	11.10
80	176	1.77	4.16	6.87	7.01	8.89	9.74	11.00
85	185	1.78	4.17	6.87	7.02	8.87	9.74	10.91
90	194	1.79	4.19	6.88	7.03	8.85	9.75	10.82
95	203	1.81	4.20	6.89	7.04	8.83	9.76	10.73

During calibration the instrument will display the pH buffer value at 25 °C.

- Press **CAL** when the instrument is in **RELATIVE mV** measurement mode. The relative mV value and the temperature values are displayed.
- Use the ▲/▼ keys if you want to change the displayed relative mV value.



- When the reading is stable, in mV range and the Relative mV offset is inside the offset window (±2000 mV), **CFM** functional key is displayed.



- Press **CFM** to confirm relative mV calibration. The instrument will return to measurement mode.
- If the absolute mV reading is out of range or the Relative mV offset is out of the offset window, "**Wrong relative offset**" message is displayed.

Change the input value or the Relative mV value to complete the calibration process.

It is recommended to calibrate the instrument frequently, especially if high accuracy is required.
The ISE range should be recalibrated:

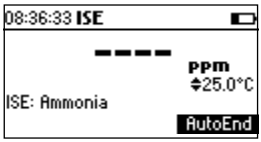
- Whenever the ISE probe or ion charge is changed.
- At least once a week.
- After testing aggressive chemicals.
- When calibration alarm time out is expired- **"CAL DUE"** tags blinks (if feature is enabled).

Due to electrode conditioning time, the electrode must be kept immersed a few seconds to stabilize. The user will be guided step by step during calibration with easy to follow tags on the LCD. This will make the calibration a simple and error-free procedure.

PROCEDURE

Select the proper ISE probe in **SETUP** menu or select the proper Ion Charge (see **SETUP** for details, page 31).

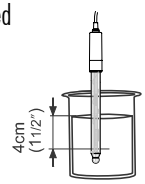
Note: If ISE probe is not calibrated in at least one point, the "----" will be displayed.



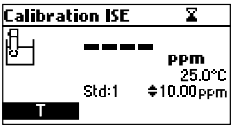
Pour small volumetrically measured 50 mL of calibration standard solutions and transfer into clean beakers. If possible, use plastic beakers to minimize any EMC interferences.
For accurate calibration and to minimize cross-contamination, use two beakers for each standard solution. One for rinsing the electrode and one for calibration.
The instrument offers a choice of six memorized standard solutions: 0.1, 1, 10, 100, 1000, 10000 ppm and calibration up to five points. For fluoride electrode the 2 ppm standard is also available.
Remove the protective cap from the ISE electrode.

FIVE POINT CALIBRATION

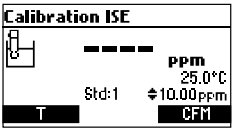
- Immerse the ISE electrode approximately 4 cm (1½") into the less concentrated standard solution and stir gently.

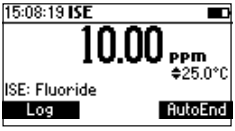


- Press **CAL**. The primary LCD will displays the ion concentration in the selected unit or "---" if not calibrated and first standard value.



- If necessary, press the ▲/▼ keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected standard, the **CFM** functional key is displayed.





- Press **CFM** to confirm calibration.
- The calibrated value and the second expected standard value will be displayed.
- After the first calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the second calibration solution.
- If necessary, press the ▲/▼ keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected standard, the **CFM** functional key is displayed.
- Press **CFM** to confirm calibration.
- The calibrated value and the third expected standard value will be displayed.
- After the second calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the third calibration solution.
- If necessary, press the ▲/▼ keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected standard, the **CFM** functional key is displayed.
- Press **CFM** to confirm calibration.

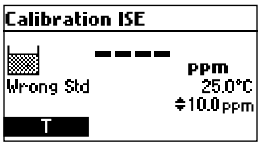
- The calibrated value and the fourth expected standard value will be displayed.
- After the third calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the fourth calibration solution.
- If necessary, press the ▲/▼ keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected standard, the **CFM** functional key is displayed.
- Press **CFM** to confirm calibration.
- The calibrated value and the fifth expected standard value will be displayed.
- After the fourth calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the fifth calibration solution.
- If necessary, press the ▲/▼ keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and within range of the selected standard, the **CFM** functional key is displayed.
- Press **CFM** to confirm calibration. The instrument stores the calibration value and returns to normal measurement mode.

Note: The instrument will automatically skip the standard solutions used during calibration.

FOUR, THREE, TWO or ONE POINT CALIBRATION

- Proceed as described in **"FIVE POINT CALIBRATION"** section.
- Press **ESC** or **CAL** key after the appropriate accepted calibration point. The instruments will return to measurement mode and will memorize the calibration data.

ERROR SCREENS

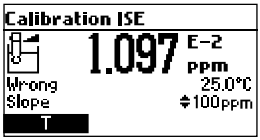


Wrong standard

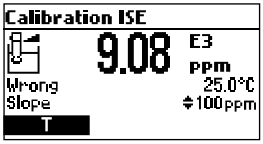
The calibration cannot be confirmed.
The message appears if mV input is out of ±2000 mV range.

Wrong slope

The calibration cannot be confirmed.
This message is displayed if slope is out of the accepted range.
Slope under accepted value (30 % default slope).



Slope over accepted value (130 % default slope).



Wrong old slope

An inconsistency between new and previous (old) calibration is detected. Clear old calibration parameters and proceed calibration from the current point. The instrument will keep all confirmed values during current calibration.
The instrument will display "----" on the primary LCD if is not calibrated or after all calibrations are cleared.
If **"Clear"** is pressed during the first calibration point, the instrument returns to measurement mode.

Notes: Press T functional key or MODE to select temperature value to be changed if the temperature probe is not connected.
ISE range is not temperature compensated.

GLP is a set of functions that allows storage and retrieval of data regarding the maintenance and status of the electrode.
All data regarding pH, Rel mV or ISE calibration is stored for the user to review when necessary.

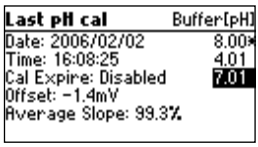
EXPIRED CALIBRATION

The instrument is provided with a real time clock **(RTC)**, in order to monitor the time elapsed since the last pH calibration.
The real time clock is reset every time the instrument is calibrated and the **"Expired Calibration"** status is triggered when the instrument detects a calibration time out. The **"CAL DUE"** tags will start blinking to warn the user that the instrument should be recalibrated.
The calibration time out can be set (see **SETUP** for details, page 31) from 1 to 7 days or can be disabled.
For example, if a 4 days time out has been selected, the instrument will issue the alarm exactly 4 days after the last calibration.
However, if at any moment the expiration value is changed (e.g. to 5 days), then the alarm will be immediately recalculated and appear 5 days after the last calibration.

Notes: When the instrument is not calibrated or calibration is cleared (default values loaded) there is no "Expired Calibration", and the display always shows the "CAL DUE" tags blinking.
When an abnormal condition in the RTC is detected, the instrument forces the "Expired Calibration" status.

LAST pH CALIBRATION DATA

The last pH calibration data is stored automatically after a successful calibration.
To view the pH calibration data, press **GLP** when the instrument is in the pH measurement mode.

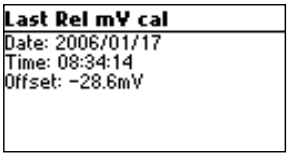


The instrument will display a lot of data including calibration buffer, offset, slope, electrode condition.

Note: Buffers displayed in video inverse mode are from previous calibrations. The custom buffers are marked with an "" on the right side of the buffer value. "No user calibration" message is displayed if all calibration are cleared or the instrument was not calibrated in the pH range.*

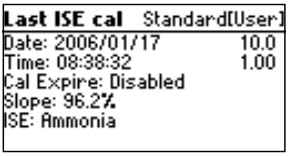
LAST RELATIVE mV CALIBRATION DATA

Last Relative mV calibration data is stored automatically after a successful calibration.
To view the Relative mV calibration data, press **GLP** key while in Relative mV measurement mode.
The instrument will display the Relative mV GLP information: calibration date, time and offset.



LAST ISE CALIBRATION DATA

Last ISE calibration data is stored automatically after a successful calibration.
To view the ISE calibration data, press GLP while in ISE measurement mode.
The instrument will display the ISE calibration information: calibration date, time, slope, calibration status and electrode type.



Notes: Press GLP or ESC at any moment and the instrument will return to measurement mode.
If calibration has not been performed, the instrument displays "No user calibration" message.
The calibration standards from previous calibration are displayed in video inverse mode.

Setup mode allows viewing and modifying the measurement parameters.
These are general **SETUP** parameters for all the ranges and range specific parameters.
The following table lists the general **SETUP** parameters, their valid range and the factory default settings.

	Description	Valid value	Default
Backlight	Backlight level	0 to 7	4
Contrast	Contrast level	0 to 20	10
Auto light off	Time until backlight is ON	1, 5, 10, 30 min	1
Auto power off	Time after the instrument is powered OFF	Disabled 5, 10, 30, 60 min	30
Date/Time		01.01.2006 to 12.31.2099 00:00 to 23:59	current date/time
Time Format		AM/PM or 24 hours	24 hours
Date Format		DD/MM/YYYY MM/DD/YYYY YYYY/MM/DD YYYY-MM-DD Mon DD, YYYY DD-Mon-YYYY YYYY-Mon-DD	YYYY/MM/DD
Language	Message display language	Up to four languages	English
Temperature unit		°C or °F	°C
Beep ON	Beeper Status	Enabled or Disabled	Disabled
Instrument ID	Instrument Identification	0000 to 9999	0000
Baud RAte	Serial Communication	600, 1200, 2400, 4800, 9600	9600
Meter information	Displays general information		

The following table lists the specific range parameters.

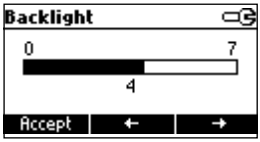
Item	Description	Valid value	Default
Calibration Timeout (pH & ISE)	Number of days after Calibration warning is displayed	Disable, 1 to 7 days	Disable
First point mode (pH)	Management of 1 point calibration	Replace or offset	Replace
Custom buffer (pH)	Custom buffer setting	Max. 5 buffers	No
View calibration points (pH)	Display calibration points	Enable or disabled	Enable
Display out of Cal. Range Warning		Enable or disabled	Enable
ISE probe (HI98191 only)	Type of ISE probe	Custom or Standard (17)	Fluoride
ISE unit (HI98191 only)		User, ppt, g/L, ppm, mg/L, ppb, µg/L, mg/mL, M, mol/L, mmol/L, % W/V	ppm

GENERAL PARAMETER SCREENS

Backlight

Highlight *Backlight*.

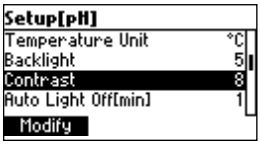
Press **Modify**.



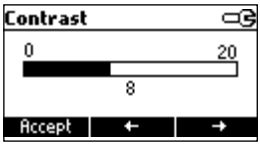
Use ← / → keys to change the intensity then press **Accept** to confirm.
Press **ESC** to leave without changing.

Contrast

Highlight *Contrast*.



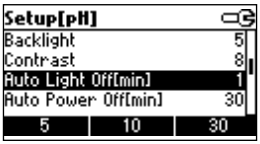
Press **Modify**.



Use ← / → keys to change contrast then press **Accept** to confirm.
Press **ESC** to leave without changing.

Auto Light Off

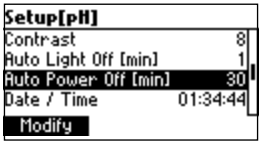
Highlight *Auto Light Off*.



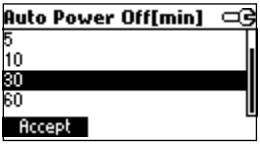
Press 5, 10 or 30 to change settings.

Auto Power Off

Highlight *Auto Power Off*.



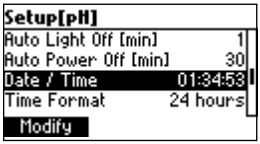
Press **Modify**.



Press ▲/▼ keys to select interval then press **Accept**.
Press **ESC** to leave without changing.

Date/Time

Highlight *Date/Time*.

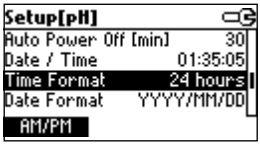


Press **Modify**.

Use ← / → keys to select item.
Use ▲/▼ keys to change focused values.
Press **Accept** to confirm new setting, or **ESC** to leave without changing.

Time Format

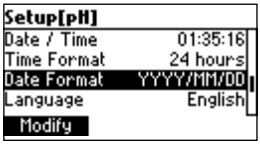
Highlight *Time Format*.



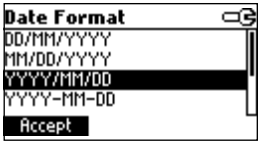
Press displayed functional key to change the option.

Date Format

Highlight *Date Format*.



Press **Modify**.



Use ▲/▼ keys to select date format then press **Accept**.
Press **ESC** to leave without changing.

Language

Highlight *Language*.

Use the desired functional key to change the option. Wait until new language is loaded. If language load fails the instrument will try to reload current language.
If any language can't be loaded, the instrument will work in safe mode. In this mode all messages are displayed in English and **Help** is not available.

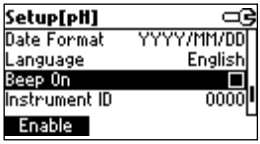
Temperature Unit

Highlight *Temperature Unit*.

Press the displayed functional key in order to change the temperature unit.

Beep On

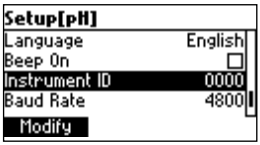
Highlight *Beep On*.
Press the displayed functional key to enable/disable beep.



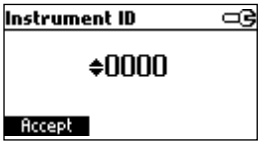
When enabled, beep sounds as a short beep every time a key is pressed or when the calibration can be confirmed.
A long beep alert that the pressed key is not active or a wrong condition is detected while in calibration.

Instrument ID

Highlight *Instrument ID*.



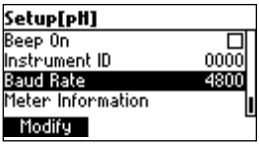
Press **Modify**.



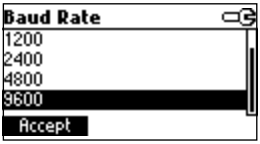
Use ▲/▼ keys to change the instrument ID.
Press **Accept** to confirm or **ESC** to exit without saving.

Baud Rate

Highlight *Baud Rate*.



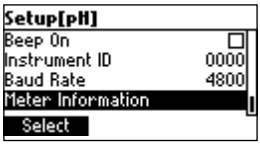
Press **Modify**.



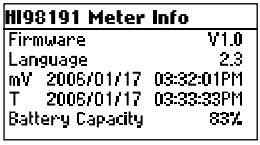
Use ▲/▼ keys to select the desired communication baud.
Press **Accept** to confirm or **ESC** to exit.

Meter information

Highlight *Meter Information*.



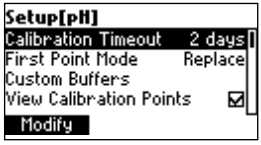
Press **Select**.
The meter informations are displayed:
-firmware version
-language version
-mV and temperature factory calibration time/date
-battery capacity



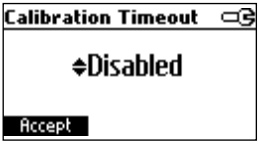
RANGE SPECIFIC PARAMETERS SCREENS

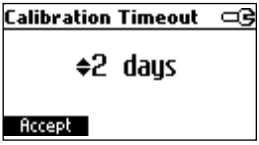
Calibration Timeout

Highlight *Calibration Timeout*.



Press **Modify**.



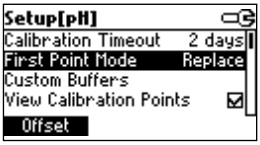


Use ▲/▼ keys to set desired value.
Press **Accept** to confirm or **ESC** to return without saving.

Note: If enabled "CAL DUE" warning will be displayed, the set number of days after calibration is over passed.

First Point Mode

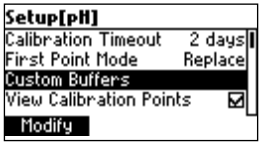
Highlight *First Point Mode*.



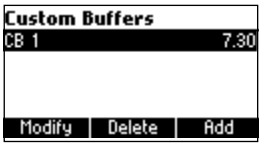
Press the displayed functional key in order to change the option.
First point mode refers to the behavior of the instrument regarding "**One point calibration**".
If **Offset** is set, after one point calibration the instrument evaluate the offset and keep unchanged the slopes.

Custom Buffers

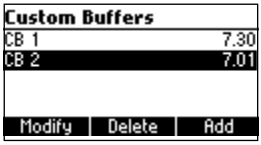
Highlight *Custom Buffers*.



Press **Modify**.

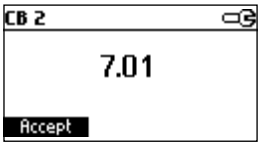


Press **Delete** to delete focused buffer.



Press **Add** to add a new buffer to the list (max 5).

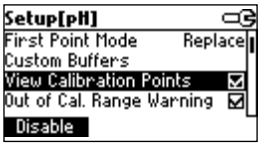
Press **Modify** to set custom buffer value.



Use ▲/▼ keys to change the value.
Press **Accept** to confirm custom buffer value or **ESC** to exit without saving.

View Calibration Points

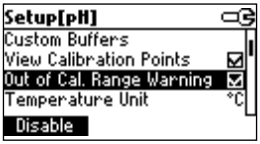
Highlight *View Calibration Points*.



Press the displayed functional key to change option.
If option is enabled the calibration buffers corresponding to the last calibration are displayed in the pH measurement screen.

Out of Calibration Range Warning

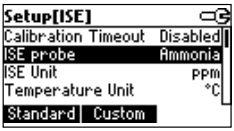
Highlight *Out of Cal.Range Warning*.



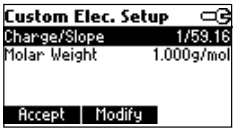
Press the displayed functional key in order to change option.
If enabled, the **"Out Cal Range"** message will be displayed if the pH reading is not within the calibration range.

ISE probe

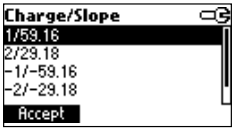
Highlight *ISE probe*.



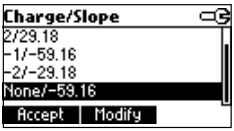
Press **Custom** in order to set the parameters for a custom probe.
Press **Standard** in order to select one probe from the standard probes list.
If **Custom** is pressed:



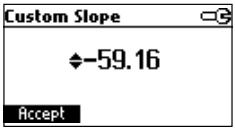
Use ▲/▼ keys to highlight the parameter to be changed (**"Change Slope"** or **"Molar Weight"**).
Highlight *Change Slope*.



Use ▲/▼ keys in order to select the desired combination.
If **None/-59.16** is selected the slope of the probe can be changed by pressing **Modify** key.

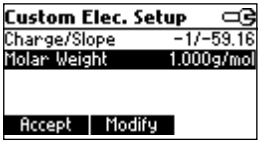


Press **Modify**.

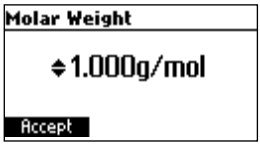


Use ▲/▼ keys to change the slope.
Press **Accept** to confirm or **ESC** to exit.

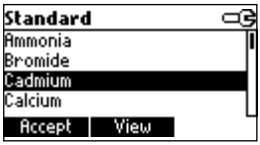
Highlight *Molar Weight*.



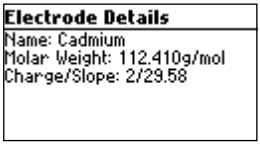
Press **Modify** in order to change molar weight.



Use ▲/▼ keys to change the value. Press **Accept** to confirm or **ESC** to exit.
If **Standard** was pressed.

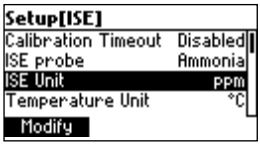


Use ▲/▼ keys to highlight the desired electrode.
Press **Accept** to confirm setting or **ESC** to exit.
Press **View** to see probe parameters.

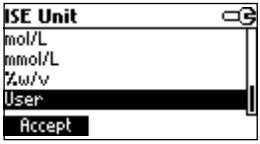


ISE Unit

Highlight *ISE Unit*.



Press **Modify**.

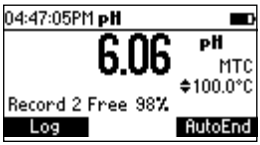


Use ▲/▼ key to select unit.
Press **Accept** to confirm selection or **ESC** to exit.

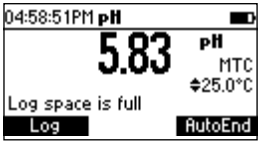
Note: If the unit is changed or "User" is selected a warning message will be displayed to alert that the ISE range must be calibrated.
If a new probe was selected or custom probe parameter are changed, the ISE range must be calibrated.

This feature allows the user to log pH, Rel mV or ISE measurements. All logged data can be transferred to a PC through the **USB** port using HI92000 application.
The maximum logging space is 300 for HI98191 and 200 for HI98190 record locations (100 records on each range).

LOGGING THE CURRENT DATA



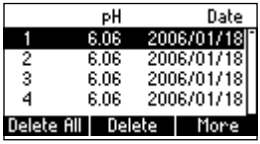
To store the current reading into memory, press **LOG** while in measurement mode.
The instrument will display for few seconds the record number and the amount of the free log space.
If the LOG space is full, the **"Log space is full"** message will be displayed for few seconds when



Log key is invoked. Enter View Logged Data Mode and delete records in order to free log space.

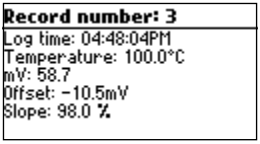
VIEW LOGGED DATA

Press **RCL** to retrieve the information stored while in measurement mode for the specific range.

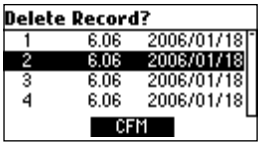


The list of records is displayed.
If no data were logged, the instrument will display **"No Records"** message.
Use ▲/▼ keys to scroll between the records from the list.
Press **Delete All** to enter Delete All screen.
Press **Delete** to enter Delete records screen.
Press **More** to view more information of the focused record.

If **More** is pressed.

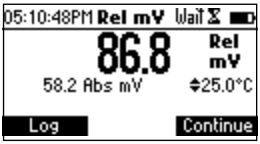


Use ▲/▼ keys to scroll between complete log information.
If **Delete** is pressed.

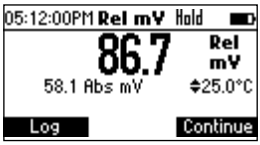


Use ▲/▼ key to focus the record to be deleted and then press **CFM**.
Press **ESC** to exit.
If **Delete All** is pressed the instrument asks for confirmation.
Press **CFM** to confirm or **ESC** to exit without deleting.

To freeze the first stable reading on the LCD press **AutoEnd** while the instrument is in measurement mode.



The "**Wait**" symbol will blink until the reading is stable.
When the reading is stable, "**Hold**" icon will be displayed.

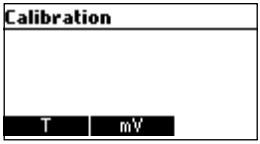


Press **Continue** in order to enter continuous reading mode.

All the instruments are factory calibrated for mV and temperature.
Hanna Instruments's temperature probes are interchangeable and no temperature calibration is needed when they are replaced.
If the temperature or ORP measurements are inaccurate, calibration should be performed.
For an accurate recalibration, contact your local Hanna Instruments Office or follow the instructions below.

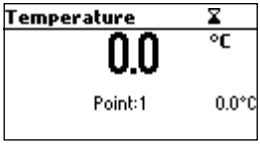
ENTER CALIBRATION MODE

With the instrument off, press and hold down the ▲/▼ then power on the instrument. The calibration screen is displayed. Press **"T"** functional key to enter the temperature calibration mode.



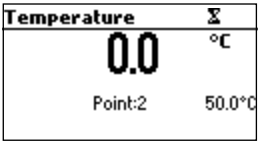
TEMPERATURE CALIBRATION

- Prepare a vessel containing ice and water and another one containing hot water (at approximately 50 °C or 122 °F). Place insulation material around the vessels to minimize temperature changes.
- Use a calibrated thermometer with a resolution of 0.1 °C as a reference thermometer. Connect the temperature probe to the appropriate socket.

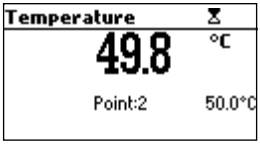


- Immerse the temperature probe or the pH probe including temperature sensor into the vessel with ice and water as close as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.
- Use the ▲/▼ keys to set the calibration point value to that of ice and water mixture, measured by the reference thermometer. When the reading is stable and within range of the selected calibration point, the **CFM** functional key is displayed.

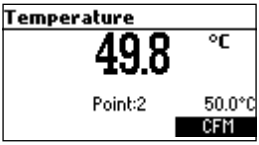
- Press **CFM** to confirm.
- The second expected calibrated point is displayed.



- Immerse the temperature probe into the second vessel as close as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.



- Use the ▲/▼ keys to set the calibration point value to that of the hot water.
- When the reading is stable and within range of the selected calibration point, **CFM** functional key is displayed.



- Press **CFM** to confirm. The instrument returns to measurement mode.

Note: Use ▲/▼ keys to change calibration point if necessary (±10.0 °C) around the point. If the reading is not within range of the selected calibration point, "Wrong" message will blink. Change the temperature probe and restart calibration.

mV CALIBRATION

A two point calibration can be performed at 0 mV and 1800 mV.

- Attach to the BNC connector a mV simulator with an accuracy of ±0.1 mV.
- Enter the calibration screen. Press **mV** functional key.
- Set **0.0 mV** on the simulator.
- When the reading is stable and within range of the selected calibration point, the **CFM** functional key is displayed.
- Press **CFM** to confirm. The second calibration point of 1800 mV will be displayed.

- Set **1800.0 mV** on the simulator.
- When the reading is stable and within range of the selected calibration point, the **CFM** functional key is displayed.
- Press **CFM** to confirm. The instrument returns to calibration screen.
- Press **ESC** to return to measurement mode.

Notes: If the reading is not within range of the selected calibration point, "WRONG" tag will blink. Verify calibration condition or contact your local Hanna Instruments Office if you cannot calibrate.
Press CAL or ESC in any moment of the calibration process. The instrument will return in the measurement mode.

Data transmission from the instrument to the PC can be done with the HI92000 Windows® compatible software (optional). HI92000 also offers graphing and on-line help feature.
Data can be exported to the most popular spreadsheet programs for further analysis.
To allow our users access to the latest version of Hanna Instruments PC compatible software, we made the products available for download at http://software.hannainst.com. Select the product code and click **Download Now**. After download is complete, use the **setup.exe** file to install the software.
To connect your instrument to a PC, use an **USB** cable connector. Make sure that your instrument is switched off and plug one connector to the instrument **USB** socket and the other to the serial or USB port of your PC.

Note: If you are not using Hanna Instruments HI92000 software, please see the following instructions.

SENDING COMMANDS FROM PC

It is also possible to remotely control the instrument with any terminal program. Use an USB cable to connect the instrument to a PC, start the terminal program and set the communication options as follows: 8, N, 1, no flow control.

COMMAND TYPES

To send a command to the instrument follow the next scheme:
<command prefix> <command> <CR>
where: <command prefix> is the 16 ASCII character
<command> is the command code.

Note: Either small or capital letters can be used.

SIMPLE COMMANDS

KF1	Is equivalent to pressing **functional key 1**
KF2	Is equivalent to pressing **functional key 2**
KF3	Is equivalent to pressing **functional key 3**
RNG	Is equivalent to pressing **RANGE** key
MOD	Is equivalent to pressing **MODE** key
CAL	Is equivalent to pressing **CAL** key
UPC	Is equivalent to pressing the **UP** arrow key
DWC	Is equivalent to pressing the **DOWN** arrow key
RCL	Is equivalent to pressing **RCL** key
SET	Is equivalent to pressing **SETUP** key
CLR	Is equivalent to pressing **CLR** key

OFF Is equivalent to pressing **OFF** key

CHR xx Change the instrument range according with the parameter value (xx):

- xx=00 pH range/0.001 resolution
- xx=01 pH range/0.01 resolution
- xx=02 pH range/0.1 resolution
- xx=03 mV range
- xx=04 Relative mV range
- xx=05 ISE range (HI98191)

The instrument will answer for these commands with:

<STX> <answer> <ETX>

where: <STX> is 02 ASCII code character (start of text)
<ETX> is 03 ASCII code character (end of text)
<answer>:
<ACK> is 06 ASCII code character (recognized command)
<NAK> is 21 ASCII code character (unrecognized command)
<CAN> is 24 ASCII code character (corrupted command)

COMMANDS REQUIRING AN ANSWER

The instrument will answer for these commands with:

<STX> <answer> <checksum> <ETX>

where the checksum is the bytes sum of the answer string sent as 2 ASCII characters.
All the answer messages are with ASCII characters.

RAS Causes the instrument to send a complete set of readings in according with the current range:

- pH, temperature and mV reading on pH range.
- Rel mV, absolute mV and temperature reading on Rel mV range.
- concentration, mV and temperature reading on ppm range (HI98191).

The answer string contains:

- Meter mode (2 chars):
- 00 - pH range (0.001 resolution)
- 01 - pH range (0.01 resolution)
- 02 - pH range (0.1 resolution)
- 03 - mV range
- 04 - Rel mV range
- 05 - ISE range

- Meter status (2 chars of status byte): represents a 8 bit hexadecimal encoding.
- 0x10 - temperature probe is connected
- 0x01 - new GLP data available
- 0x02 - new SETUP parameter
- 0x04 - out of calibration range
- 0x08 - the meter is in autoend point mode
- Reading status (2 chars): R - in range, O - over range, U - under range. First character corresponds to the primary reading. Second character corresponds to mV reading.
- Primary reading (corresponding to the selected range) - 11 ASCII chars, including sign and decimal point and exponent.
- Secondary reading (only when primary reading is not mV) - 7 ASCII chars, including sign and decimal point.
- Temperature reading - 7 ASCII chars, with sign and two decimal points, always in °C.

MDR Requests the instrument model name and firmware code (16 ASCII chars).

GLP Requests the calibration data record.

The answer string contains:

- GLP status (1 char): represents a 4 bit hexadecimal encoding.
  - 0x01 - pH calibration available
  - 0x02 - Rel mV calibration available
  - 0x04 - ISE calibration available
- pH calibration data (if available), which contains:
  - the number of calibrated buffers (1 char)
  - the ion charge, with sign (2 chars)
  - the offset, with sign and decimal point (7 chars)
  - the average of slopes, with sign and decimal point (7 chars)
  - the calibration time, **yymmddhhmmss** (12 chars)
  - buffers information (for each buffer)
    - type (1 char): 0 - standard, 1 - custom
    - status (1 char): N (new) - calibrated in last calibration; O (old) - from an old calibration.
    - warnings during calibration (2 chars): 00 - no warning, 04 - Clean Electrode warning.
- buffer value, with sign and decimal point and exponent (11 chars).
- calibration time, **yymmddhhmmss** (12 chars).

- electrode condition, with sign (3 chars). The "-01" code means not calculated.
- Rel mV calibration data (if available), which contains:
  - the calibration offset, with sign (7 chars)
  - the calibration time, **yymmddhhmmss** (12 chars).
- ISE calibration data (if available), which contains:
  - the number of calibrated standards (1 char)
  - the ion charge, with sign (2 chars)
  - the calibration slope, with sign and decimal point (7 chars)
  - the calibration time, **yymmddhhmmss** (12 chars)
  - standards information (for each standard)
    - type (1 char): 0 - always standard solution.
    - status (1 char): N (new) - calibrated in last calibration; O (old) - from an old calibration.
    - warnings during calibration (2 chars): 00 - no warning.
    - standard value, with sign and decimal point and exponent (11 chars).
    - calibration time, yymmddhhmmss (12 chars).

PAR Requests the setup parameters setting.
The answer string contains:

- Instrument ID (4 chars)
- Calibration Alarm time out for pH (2 chars)
- Calibration Alarm timeout for ISE (2 chars) - if ISE available
- SETUP information (2 chars): 8 bit hexadecimal encoding.
  - 0x01 - beep ON (else OFF)
  - 0x04 - degrees Celsius (else degrees Fahrenheit)
  - 0x08 - Offset calibration (else Point calibration)
- Auto Light Off time (3 chars)
- Auto Power Off time (3 chars)
- The number of custom buffers (1 char)
- The custom buffer values, with sign and decimal point, for each defined custom buffer (7 chars)
- The ID of the ISE electrode (2 chars) - if ISE available
- The molar weight of the selected ION, with sign and decimal point (9 ASCII characters)
- The ion charge (2 chars)
- The ISE unit (2 chars)

- The short name of the selected language (3 chars)

NSLx Requests the number of logged samples (4 chars).
The command parameter (1 char):
- P - request for pH range
- M - request for mV and Rel mV ranges
- I - request for ISE range

LODPxxx Requests the xxxth pH record logged data.

LODMxxx Requests the xxxth mV/Rel mV record logged data.

LODIxxx Requests the xxxth ISE record logged data (HI98191).

LODPALL Requests all pH Log on demand.

LODMALL Requests all mV/Rel mV Log on demand.

LODIALL Requests all ISE Log on demand (HI98191).

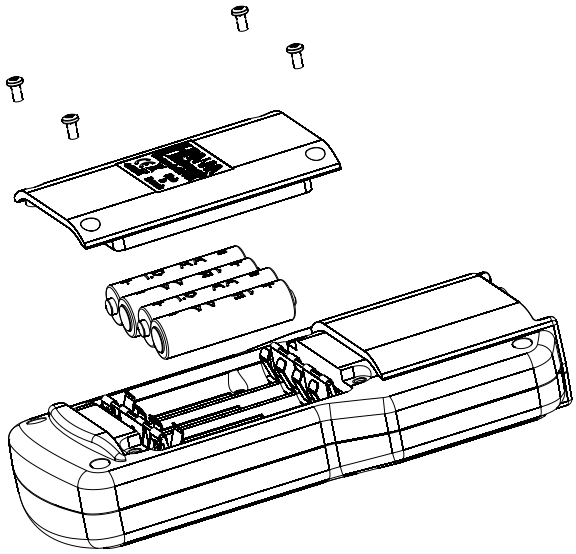
The answer string for each record contains:
- The logged mode (2 chars):
  - 00 - pH range (0.001 resolution)
  - 01 - pH range (0.01 resolution)
  - 02 - pH range (0.1 resolution)
  - 03 - mV range
  - 04 - Rel mV range
  - 05 - ISE range
- Reading status (1 char): R, O, U
- Calculated reading, with sign and decimal point and exponent (11 chars) - for pH, Rel mV and ISE range
- Temperature reading, with sign and two decimal points (7 chars)
- mV reading status (1 char): R, O, U
- The mV reading, with sign and decimal point (7 chars)
- The logged time, **yymmddhhmmss** (12 chars)
- The calibration slope, with sign and decimal point (7 chars) - not available for Rel mV range
- The calibration offset, with sign and decimal point (7 chars) - not available for ISE
- Temperature probe presence (1 char)

Notes: "Err8" is sent if the instrument is not in measurement mode.
"Err6" is sent if the requested range is not available.
"Err4" is sent if the requested set parameter is not available.
"Err3" is sent if the Log on demand is empty.
"Err9" is sent if the battery power is less than 30%.
Invalid commands will be ignored.

To replace the batteries, follow the next steps:

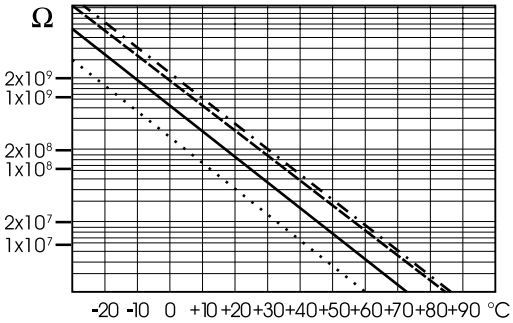
- Turn OFF the instrument.
- Open the battery compartment by removing the four screws from the back of the instrument.
- Remove the old batteries.
- Insert four new 1.5V AA batteries in the battery compartment while paying attention to the correct polarity.
- Close the battery compartment using the four screws.

If the battery capacity is less than 20 % the serial communication and the backlight feature are not available.



Note: The instrument is provided with the BEPS (Battery Error Prevention System) feature, which automatically turns the instrument off when the batteries level is too low to ensure reliable readings.

The resistance of glass electrodes partially depends on the temperature. The lower the temperature, the higher the resistance. It takes more time for the reading to stabilize if the resistance is higher. In addition, the response time will suffer to a greater degree at temperatures below 25 °C (77 °F).



Since the resistance of the pH electrode is in the range of 50 – 200 MΩ, the current across the membrane is in the pico Ampere range. Large currents can disturb the calibration of the electrode for many hours.

For these reasons high humidity environments, short circuits and static discharges are detrimental to a stable pH reading.

The pH electrode's life also depends on the temperature. If constantly used at high temperatures, the electrode life is drastically reduced.

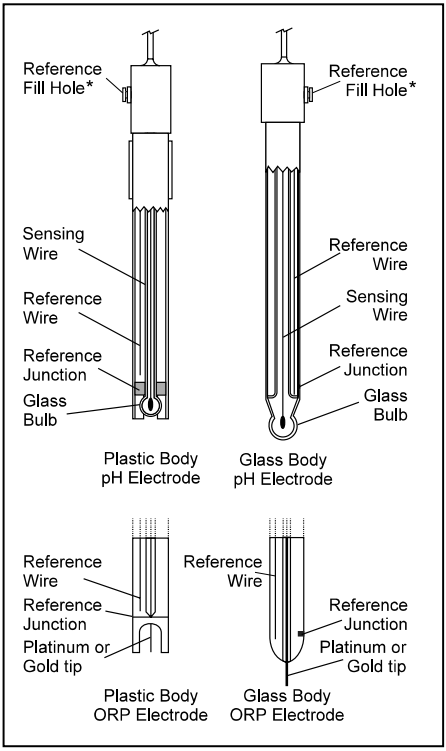
Typical Electrode Life

Ambient Temperature 1 – 3 years
90 °C (194 °F) Less than 4 months
120 °C (248 °F) Less than 1 month

Alkaline Error

High concentrations of sodium ions interfere with readings in alkaline solutions. The pH at which the interference starts to be significant depends upon the composition of the glass. This interference is called alkaline error and causes the pH to be underestimated. Hanna Instruments's glass formulations have the indicated characteristics.

Sodium Ion Correction for the Glass at 20-25 °C (68-77 °F)		
Concentration	pH	Error
0.1 Mol L^{-1} Na^{+}	13.00	0.10
	13.50	0.14
	14.00	0.20
1.0 Mol L^{-1} Na^{+}	12.50	0.10
	13.00	0.18
	13.50	0.29
	14.00	0.40



*Not present in gel electrodes.

PREPARATION PROCEDURE

Remove the electrode protective cap.

DO NOT BE ALARMED IF ANY SALT DEPOSITS ARE PRESENT. This is normal with electrodes and they will disappear when rinsed with water.

During transport tiny bubbles of air may have formed inside the glass bulb. The electrode cannot function properly under these conditions. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.

If the bulb and/or junction are dry, soak the electrode in HI70300 Storage Solution for at least one hour.

For refillable electrodes:

If the filling solution (electrolyte) is more than 21/2 cm (1") below the fill hole, add HI7082 or HI8082 3.5M KCl Electrolyte Solution for double junction or HI7071 or HI8071 3.5M KCl+AgCl Electrolyte Solution for single junction electrodes.

For faster response, unscrew the fill hole screw during measurements.

For AmpHel® electrodes:

If the electrode does not respond to pH changes, the battery run down and the electrode should be replaced.

MEASUREMENT

Rinse the pH electrode tip with distilled water. Immerse the tip (bottom 4 cm /1½" ensuring the reference junction is submerged) in the sample and stir gently for a few seconds.

For a faster response and to avoid cross-contamination of the samples, rinse the electrode tip with a few drops of the solution to be tested, before taking measurements.

See that the sleeve holes of the ORP probe are completely submerged.

STORAGE PROCEDURE

To minimize clogging and assure a quick response time, the glass bulb and the junction of pH electrode should be kept moist and not allowed to dry out.

Replace the solution in the protective cap with a few drops of HI70300 or HI80300 Storage Solution or, in its absence, Filling Solution (HI7071 or HI8071 for single junction and HI7082 or HI8082 for double junction electrodes). Follow the Preparation Procedure on page 56 before taking measurements.

Note: NEVER STORE THE ELECTRODE IN DISTILLED OR DEIONIZED WATER.

PERIODIC MAINTENANCE

Inspect the electrode and the cable. The cable used for connection to the instrument must be intact and there must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. Connectors must be perfectly clean and dry. If any scratches or cracks are present, replace the electrode.

Rinse off any salt deposits with water.

pH Probe Maintenance

For refillable electrodes:

Refill the reference chamber with fresh electrolyte (HI7071 or HI8071 for single junction or HI7082 or HI8082 for double junction electrodes). Allow the electrode to stand upright for 1 hour.

Follow the Storage Procedure above.

pH CLEANING PROCEDURE

- General Soak in Hanna Instruments HI7061 or HI8061 General Cleaning Solution for approximately ½ hour.
- Protein Soak in Hanna Instruments HI7073 or HI8073 Protein Cleaning Solution for 15 minutes.
- Inorganic Soak in Hanna Instruments HI7074 Inorganic Cleaning Solution for 15 minutes.
- Oil/grease Rinse with Hanna Instruments HI7077 or HI8077 Oil and Fat Cleaning Solution.

IMPORTANT: After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water, refill the reference chamber with fresh electrolyte (not necessary for gel-filled electrodes) and soak the electrode in HI70300 or HI80300 Storage Solution for at least 1 hour before taking measurements.

SYMPTOMS	PROBLEM	SOLUTION
Slow response/excessive drift.	Dirty pH electrode.	Soak the electrode tip in HI7061 solution for 30 minutes and then follow the Cleaning Procedure.
Reading fluctuates up and down (noise).	Clogged/dirty junction. Low electrolyte level (refillable electrodes only).	Clean the electrode. Refill with fresh electrolyte (refillable electrodes only).
Display shows blinking full scale value.	Reading out of range.	Check that sample is within measurable range
mV scale out of range.	Dry membrane or dry junction.	Soak electrode in HI70300 storage solution for at least 30 minutes.
Display shows ▲▼ symbol in front of temperature reading.	Out of order or missing temperature probe.	Replace temperature probe or check the connection.
Display shows "**Clean electrode**" blinking.	Difference between new and previous calibration has been detected.	Clean electrode and recalibrate. If the problem remains, check the buffer solutions.
Meter does not work with temperature probe.	Broken temperature probe.	Replace temperature probe.
Meter fails to calibrate or gives faulty readings.	Broken pH electrode.	Replace electrode.
Error messages are displayed during pH calibration procedure.	Wrong or contaminated buffer, electrode dirty or broken.	Check that buffer solution is correct and fresh.
Meter shuts off.	Dead batteries; Auto-off feature is enabled: in this case, meter shuts off after selected period of non-use.	Replace batteries; Press **ON/OFF**.
"**Errxx**" message at start up.	Internal error.	Contact your local Hanna Instruments Office.
The instrument does not start when pressing **ON/OFF**.	Initialization error.	Press and hold down **ON/OFF** for about 20 seconds or disconnect and then connect the batteries.

Certification

All Hanna Instruments conform to the **CE European Directives.**

RoHS compliant

Disposal of Electrical & Electronic Equipment. The product should not be treated as household waste. Instead hand it over to the appropriate collection point for the recycling of electrical and electronic equipment which will conserve natural resources.

Disposal of waste batteries. This product contains batteries, do not dispose of them with other household waste. Hand them over to the appropriate collection point for recycling.

Ensuring proper product and battery disposal prevents potential negative consequences for the environment and human health. For more information, contact your city, your local household waste disposal service, the place of purchase or go to www.hannainst.com.

Recommendations for Users

Before using this product, make sure it is entirely suitable for your specific application and for the environment in which it is used. Any variation introduced by the user to the supplied equipment may degrade the meters' performance. For yours and the meter's safety do not use or store the meter in hazardous environments.

Warranty

The HI98190 and HI98191 are warranted for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. Electrodes and probes are warranted for six months. This warranty is limited to repair or replacement free of charge.

Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered.

If service is required, contact your local Hanna Instruments Office. If under warranty, report the model number, date of purchase, serial number and the nature of the problem. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization (RGA) number from the Technical Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packed for complete protection.

Hanna Instruments reserves the right to modify the design, construction or appearance of its products without advance notice.

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HANNA® instruments

MAN98191

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Appendix E

Microsoft Word files of Revised Hazardous Waste Facility Permit, Parts 1–11, Attachment A, Attachment C, Attachment E, Attachment G.6, Attachment J, and Attachment N (on CD included with this document)