1.0 Purpose and Scope

This procedure describes the Sandia National Laboratories (SNL) process for the collection of video-log data and information from boreholes or completed wells. Measurements include: 1) depth-to-water (DTW) using a water-level meter, and 2) visual information using a borehole video camera. Objectives of video logging monitoring wells are to: 1) assess the overall integrity of the well casing or borehole wall, 2) qualify and quantify scale and mineral build-up within the casing walls, 3) observe and determine the perforated and/or screened zones, as well as qualifying the ‘openness’ of perforations and screen, 4) determine the bottom-hole depths, and 5) visually qualify the water quality or clarity. All collected information will be used to determine: 1) depths for pump or transducer installations within each well, 2) whether a well needs remediation, recompletion or replacement, and 3) update information on each well that is presently on record. All video logged wells will have SNL non-Quality Assurance (NQ) electronic reference media such as a DVD for the downhole video systems. Scientific notebook (SN) entries will be provided for those wells that require QA documentation as a record and associated pedigree to assist in all aforementioned determinations.

This Activity/Project Specific Procedure (SP) is intended to direct SNL technical personnel in the procedures needed to obtain high-quality data that meet SNL Quality Assurance (QA) standards. This SP is supplemented by the operation manuals associated with each borehole video system. All activities will be documented in the appropriate SN according to NP 20-2, Scientific Notebooks. This SP will support activities described in Waste Isolation Pilot Plant (WIPP) Test Plans TP 06-01, Monitoring Water Levels in WIPP Wells and TP 03-01, Test Plan for Testing of Wells at the WIPP Site. This SP may also be used in support of Work-for-Others or New Mexico Small Business Assistance activities that may be described in associated work plans or test plans.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located on the Sandia National Laboratories (SNL) WIPP Online Documents web site.
2.0 Implementation Actions

2.1 Safety

The activities described in this SP shall conform to SNL Environmental Safety and Health programs (ES&H). All activities described in this SP are also subject to ES&H requirements governed by the WIPP Industrial Safety Program and the WIPP Industrial Hygiene Program when work is conducted within the WIPP site land withdrawal boundary. The operations in this procedure are performed in field conditions. Biological and environmental hazards associated with field work are addressed in the ES&H documents for the hydrology group.

2.2 Responsibilities

The SNL Manager Designee(s) (SMD) is/are responsible for implementing the requirements of this procedure.

The Technical Staff is responsible for performing the measurements and installations outlined in this procedure, documenting all required information described in this SP, and assuring the latest revision of this document is followed.

If the procedure cannot be worked as written, the user has the responsibility to stop work and resolve all concerns with the SNL Manager or SMD, prior to proceeding with the work.

2.3 Equipment

2.3.1 Water-Level Sounder

Water levels in wells will be measured according to SP 9-7, *WIPP Well Water-Level Monitoring*. The depth-to-water (DTW) is to be measured from the north side of casing/tubing (Figure 1). If any steps cannot be accomplished as specified in SP 9-7, they must be noted in the SN.

*Figure 1.* Image of Wellhead H10-A – DTW will be measured in this well, and all other wells, from the north side of the casing. North is represented by the pink paint on the casing top.
2.3.2 Aries Camera Trailer

The Aries Camera Trailer and Water Well Inspection System provides a unique capability to make downhole assessments of the interior of water wells or boreholes. More details on the use and capabilities of this system are described in the sections that follow.

Figures 2 - 5. Images depicting both exterior and interior views of the Aries Water Well Inspection System components/equipment contained within the Aries Camera Trailer.
Housed within the Video Logging Camera Trailer (Aries Camera Trailer), are all the essentials required to accurately video log and qualitatively and quantitatively assess the integrity of a borehole or completed well. The Aries Water Well Inspection System is depicted in this section (some of the information presented here applies to the Laval R-cam 1300/SC-166 Portable Borehole Video System discussed in Appendix B); Aries system’s hardware and equipment includes the items listed below and visually depicted in Figures 2 – 5:

- **Borehole Cameras** – ready to attach to the rear boom by .270” wire cable
- **WW1500** cable reel winch with approximately 2000’ of .270” wire cable, spooled, with a guard and winch counter
  
  **NOTE:** Always be aware of the position of the cable on the spool, and that the cable is seating itself PROPERLY on the spool. This is especially important at the end-run returns (the sidewalls) of each right, then to left passing cable collection on the spool
- **Centralizer spring sets** (casing guard) to protect the camera and to ensure that the camera travels properly downhole
- **19-gallon freshwater tank** equipped with a pump and hose attachment wand for cleaning camera and cable
- **Onboard Gas Generator with 14-gallon fuel tank and 12-volt DC battery mounted on trailer tongue**
- **Onboard fire extinguisher, first aid kit, and eye wash station**
- **Operator chair, rack-mounted computer with DVD burner, video overlay system, Camera Control Unit (CCU), & system power supply (video overlay), desktop control unit, LCD video monitors, and uninterruptable power supply (UPS)**
- **Internal job-box (bench seat) containing DVDs (-R), environmental-friendly all-purpose cleaner, paper towels, nitrile lab gloves, cable connections, batteries, spare camera parts, hand tools, drinking water and miscellaneous Personal Protective Equipment (PPE)**
- **WIPP Well Construction Diagrams Notebook (as required)**
- **Video Logging Scientific Notebook (SN), Long-Term Monitoring (LTM) SN, laptop bag with well keys and well labels**
- **Tailgate Safety Briefing form, and previous video log reports/summaries**

### 2.3.3 Borehole Cameras

Video logging of WIPP Monitoring Wells will be performed using a borehole camera chosen by the SMD. The Aries system can utilize three camera models, two made by Aries and one by Laval. The Aries BT9700 Zoom Dual-View Camera is capable of video logging wells from 4 to 24 inches in diameter, and the Aries WC1750 Slim Line Dual-View Camera is capable of video logging wells from 2 to 12 inches in diameter. Both Aries cameras have a side and downhole view. The Laval DC-5150 borehole camera is capable of video logging wells from 3 to 30 inches in diameter in both side and downhole views. The Laval R-Cam 1300/SC-166 Portable, Borehole Video System can either be operated as a stand-alone system, or be installed in, and operated from the Aries camera trailer, and former Laval camera trailer. The SC-166 borehole camera is capable of video logging wells and boreholes 2 to 10 inches in diameter in downhole view only.

### 2.4 Recommendations and Observation Reporting

The objectives of video logging wells are to provide the client with the following:

- Assess the overall condition/integrity of the well casing and the existence of casing or borehole collapse, and/or bent or offset casing
• Qualify and quantify scale buildup and mineral precipitation within the casing walls
• Observe and determine the perforated and/or screened zones, as well as qualifying the ‘openness’ of perforations and/or screen slots
• Determine the bottom-hole depths
• Visually qualify the water quality or clarity
• Assess the integrity of threads connecting casing pipe sticks
• Determine if biofouling has occurred or if anthropogenic contaminants have entered the well
• Recommend recompletion, remediation, or replacement strategies for each logged monitoring well

2.5 Pulling/Reinstalling a Pressure Gauge

In the event that a Pressure Gauge (PT) must be removed and reinstalled from the well, a monitoring test must be stopped prior to removal and a new test started after reinstallation. This process is outlined succinctly in SP 9-7, *WIPP Well Water-Level Monitoring*, and will be comprehensively followed.

3.0 Records

The following records, generated through implementation of this procedure, shall be prepared, and submitted to the WIPP Records Center in accordance with NP 17-1 (Records).

QA Record
- Scientific Notebooks

Non-Quality (NQ) Record
- Recorded DVDs

4.0 Appendices

Appendix A: Operating Procedure and Instructions for the Aries Water Well Inspection System
Appendix B: Operating Procedure and Instructions for the Laval R-Cam 1300/SC-166 Portable, Borehole Video System
Appendix A
Operating Procedure and Instructions for the Aries Water Well Inspection System

NOTE: The Aries Water Well Inspection System is mounted inside the Aries Camera Trailer and is the primary logging system for video logging wells and boreholes (Figures A1 and A2).

A. INITIAL SETUP
1. Prior to Leaving SNL with the Aries Video Logging Camera Trailer:
   a. Sync the laptop computer (laptop) to the WIPP data computer. (Perform this step, and related pressure gauge (PT) steps in this appendix, as required.)
   b. Log the time into the LTM-SN.
      NOTE: It is recommended to remove the PT and cable one day prior, so that the well water will have sufficient time to settle.
   c. Check camera diagnostics by referencing camera’s user manual, accordingly, and verifying each parameter is in the Normal Reading range. This will be checked again in the field prior to deployment. These steps do not apply to the Laval cameras.
      1) To check Normal Reading ranges for the BT9700 camera, click on the Diagnostics button on the Desktop Control Box. The screen will display all the diagnostic readings.
      2) The WC1750 camera does not display a Diagnostics screen. To check temperature and pressure diagnostics, it uses a Red Code LED (located on side view port of camera) flashing system. Counting the red flashes in sidewall view (SWV) will provide the temperature and counting the flashes in downhole view (DHV) will provide the pressure.
NOTE: The pressure reading is the most important parameter to check prior to entering a well. The steps on how to refill a camera body is in the Nitrogen Pressure Assembly, Well Camera Instruction Manual located in the Aries red binder in the trailer and electronically available on the CPU desktop. Instructions for interpreting the LED flash codes are also provided in this manual for the WC1750 Camera. If cameras do not hold pressure consistently, send it back to Aries for maintenance.

d. Fill the wash tank with water in the rear of the Aries Camera Trailer, as required.
e. Fill the gasoline fuel tank contained in the front of the Aries Camera Trailer, as required.
f. Materials needed:
   - Aries BT9700 and WC1750 Cameras, rubber well-cover mats, light rings, spare parts, and centralizers (Figure A1)
   - Desktop camera controller (Figure A6)
   - Aries Binder with various user manuals
   - Paper towels, clean microfiber towels and nitrile lab gloves
   - RainX®, Simple Green®, or equivalent all-purpose cleaner, and water
   - USB flash drive and blank DVD (-R) discs with cases/sleeves
   - LTM laptop bag with well keys and well labels
   - Appropriate Personal Protective Equipment (PPE)
   - Video Logging SN, LTM-SN, and other appropriate SNs
   - Tailgate Safety Briefing form and previous video log reports/summaries

2. Collect Monitoring Equipment

   NOTE: Perform Steps 2.a – 2.c only if a PT is present in the well. If PT was pulled the day before, use the depth-to-water measurement recorded in the LTM-SN at the time of PT removal and record this in the Video Logging SN.

   a. Obtain a water-level sounder for DTW measurements.
   b. Obtain necessary hand tools.
   c. Obtain the water-level sounder stand; include the cable reel if the PT cable will be spooled.

3. Arrive at the well pad and conduct the Tailgate Safety Briefing and weather forecast update. (An option is to conduct the briefing before departing SNL office.)

   a. In the Video Logging SN, note the arrival time, all personnel, and the activity to be completed.
   b. Position the rear of the trailer in-line with the wellhead and unlock the wellhead cover.

   NOTE: Perform Steps 3.c – 3.i only if a PT is present in the well.

   c. Using the water-level sounder, make a DTW measurement and record this in the LTM and Video Logging SN.
   d. Connect the laptop to the PT.
   e. Stop the test on the PT, and record this in the LTM-SN.
   f. Download the PT data to the laptop.
   g. Pull the PT from the well.
   h. When the PT is at the surface, perform a surface check and record in the LTM-SN.
   i. Keep the PT safely aside (in the trailer) and start to unpack the video equipment.
   j. Position the boom directly over the wellhead.

4. Camera Setup

   a. Lift and extend the Camera Trailer boom (boom) to the desired height to install the borehole camera (Figure A1). Make sure that all the moving pulley parts and guides on/within the camera boom are properly greased with silicon spray or lube. Once desired position is achieved, lock boom in place with cotterless ring pins.
NOTE: Personnel in close proximity to the borehole video system winch and the Camera Trailer boom shall keep hands, loose clothing, and loose personal objects away from exposed moving parts, such as pulleys and sheaves.

b. **Ensure that the Camera Control Unit (CCU) is OFF** (Figure A5) – the borehole camera must be fully attached to the cable before turning the **CCU ON**.

c. Remove the cap from the cable head and ensure that the O-rings are in place; grease the O-rings on the connector head, if needed.

d. Position the centralizer on the cable head and hand tighten bolts at the top to hold in place during connection. Position the borehole camera within the centralizer, hand tighten the camera to the connector head, and tighten the centralizer at the bottom, if applicable, using a 1/16” Allen wrench. The bottom of the centralizer shall be at or above the groove that is located above the side view port lens (Figure A3). Tighten the ring connected to springs, below the top of the centralizer using a 7/16” nut driver or wrench. It is recommended for two people to complete this connection.

5. Ensure all cables are connected between the LCD monitors, desktop computer, system power supply and CCU (Figure A5) – **ENSURE THAT THE CCU IS TURNED OFF**.

6. **Generator and CCU Startup**
   a. Check generator’s fluids (oil, air filter and fuel). If fluids are good, use the interior, wall-mounted rocker switch, to **PRIME** and **START** the generator.
   
   b. Turn on the Uninterruptable Power Supply (UPS) located on the top right of electronic rack (Figure A5). **Typically, the UPS indicates a full charge with a steady green light above the [Battery in Use] label.** If the UPS is not at 100% charge, the operator(s) may see blinking lights and hear beeping sounds. If this happens, the operator may choose from
these options:
1) Allow the UPS to fully charge before turning on any other equipment in the CCU equipment rack.
2) Continue with the procedure, but in the event of a power outage, be prepared for less backup time until the UPS is fully charged.
3) See user manual for troubleshooting tips in the event the UPS does not hold charge.
c. Set the thermostat and start the air conditioner unit or heater unit, if needed.

NOTE: Do not start or stop the air conditioning or heater units once video logging has started to avoid generator voltage surges.

d. Turn on the computer located below the UPS and wait for the desktop screen (right-side monitor) to boot up and open BoreOptix® software. If right-side screen is not displaying CPU desktop screen, switch input to CPU by pressing the Auto/Exit button at the bottom of the monitor. Be sure the keyboard and mouse are plugged in to the CPU.
e. Plug in the desktop control box (Figure A6). Turn on the System Power Supply (video overlay) on top left of electronic rack and turn on CCU located under the System Power Supply (at this point, the left-side monitor should display what the camera’s view). Exercise the desktop control box switches, to ensure all the camera controls are functioning properly.
f. Check camera diagnostics thoroughly by referencing camera’s user manual, accordingly, and verifying each parameter is in the Normal Reading range. These steps do not apply to the Laval cameras.
   1) To check Normal Reading ranges for the BT9700 camera, click on the Diagnostics button on the Desktop Control Box. The screen will display all the diagnostic readings.
   2) The WC1750 camera does not display bring up a Diagnostics screen. To check temperature and pressure diagnostics, it uses a Red Code LED (located on side view port of camera) flashing system. Counting the red flashes in SWV will provide the temperature and counting the flashes in the DHV will provide the pressure.

NOTE: The pressure reading is the most important parameter to check prior to entering a well. The steps on how to refill a camera head is in the Nitrogen Pressure Assembly, Well Camera Instruction Manual located in the Aries red binder in the trailer and electronically available on the CPU desktop. Instructions for interpreting the LED flash codes are also provided in this manual for the WC1750 Camera. If cameras do not hold pressure consistently, send it back to Aries for maintenance.

7. Clean the camera lights and the lenses with RainX®, Simple Green®, or equivalent all-purpose cleaner, with clean microfiber towels – THE OUTSIDE SETUP IS NOW COMPLETE.
B. WELL WINCH CONTROLS AND CAMERA CONTROLS
1. Raising and Lowering the Borehole Camera for Front and Rear Winch Controllers
   a. Always place the winch control panel’s SPEED control knob at MIN (Figure A6).
   b. Engage the direction toggle switch to RAISE or LOWER.
   c. Place the ON/OFF switch in the ON position.
   d. Turn the SPEED control knob slowly to increase the speed - the camera should begin to
      move in the desired direction.
NOTE: The winch has two controllers, a fixed controller at the operator desk known as FRONT (DW1000, Figure A8) and a handheld controller in the REAR (DW1500) by the wash tank. To toggle power between each controller, flip the REAR/FRONT switch (located on the FRONT controller) in the desired position. If FRONT is selected, the REAR controller will not function, and vice versa.

C. RECORDING

1. Titling the Video
   a. In BoreOptix®, click the [Inspect] tab button; this will activate the Asset tab.
   b. In the [Asset] tab enter the required asset information. Fields in red are required.
   c. Click on the [Inspection] tab and enter the required Inspection information (Well Identifier, Client, and Job). Well Identifier will be the wellsite, Client will be Sandia, and Job will be WIPP. These fields will auto-create folders and save all information recorded during the video log.
   d. Once all the required fields have been filled in, the previously grayed out (inactive) Record button will now be active on the recording screen.
   e. Click the [Record] button to begin recording and logging your down hole observations.
   f. Click the Overlay Setup Info icon on right side of recording screen to display Asset information (Figure A7).

2. Positioning the Camera
   a. Using the winch controller (Figure A6) and monitor screen, lower the camera into the well.
   b. The Top-of-Casing (TOC) should be halfway up on the SWV of the camera – the TOC will be in the middle of the monitor screen (see section B, Well Winch Controls and Camera Controls for winch operations).
   c. Press the FOOTAGE Clear toggle switch down on the System Power Supply (video overlay) or click the [0.0 ft] icon on the recording window - the depth counter onscreen display should show '0000.0 F'.
   d. Reset the winch analog counter by turning its knob until it reads ‘0’.
3. Begin lowering the camera into the well in SWV - note the time in the Video Logging SN.
4. After the camera has been lowered ~1’, switch the view to DHV.
5. Alternate between camera DHV and SWV while traversing down the well borehole, to record desired observations.

6. Flagging an Observation(s) in BoreOptix® - Note the depth of important features, i.e.: wall scale, DTW, perforations, screens, joint connections/anomalies, bottom of hole, snapshots, etc.
   a. In BoreOptix®, under the [Observation] tab, click the red flag to mark your observations. Enter the corresponding code for your observation as well as any additional relevant information such as comments, percentage, etc. Footage should populate automatically and reflect what is displayed in your Video Overlay. Codes can be found in the software.
   b. Click [Save] to take a record of that observation. This observation will be displayed in the Conditions box with the code that was entered. A snapshot of that observation will be saved and displayed in the Snapshot column.
   c. Follow the steps above to record additional observations of the asset (wellbore).

7. When conveying the camera back to the surface at the end of the video log, note the depth of bottom & top of slots or perforations (perfs), DTW, and the TOC depths in the Video Logging SN.

D. VIDEO COMPLETION
1. Bring the Borehole Camera Back to TOC
   a. Again, position the camera, so the TOC is halfway up on the SWV of the camera in the monitor screen.
   b. If the camera footage counter does not return to ‘0000.0 f’ (on screen measurement), note the discrepancy in the Video Logging SN.

2. Stopping Recording and Creating the DVD.
   a. Click on [Stop] to stop recording.
   b. Click the [Print Preview] button to generate a PDF report of the asset inspection.

   NOTE: This report does not generate automatically and is only to be used as a reference for post-video logging documentation.

   c. Locate the file folder to save files on a USB. Click on the [File Directory] toolbar button. The icon represents a folder next to the [Inspect] tab
   d. Connect a USB thumb drive and save these files. Leave this window open.
   e. Insert a blank DVD (-R) disc into the CPU (check DVD for scratches before inserting). You may choose to burn the recorded video in the trailer during demobilization or at the SNL office using File Explorer or other software. This DVD will be the original to be submitted to SNL Records. Steps to burn DVD are as follows:
      1). Open the blank disk's folder, DVD RW Drive (E:).
      2). Drag files from video log folder to the DVD folder.
      3). Click on the [Drive Tools] tab and select [Finish Burning]
      4). Follow prompts and wait for DVD to finish burning process.
      5). Eject DVD and place in a sleeve/case and label accordingly (Well ID and Date).

E. BOREHOLE CAMERA REMOVAL

When bringing the camera out of well for the last time, wash the cable, the centralizer, and the camera as they come out of the borehole. Use the tennis ball as a squeegee and the rubber well cover, the pressurized wash water tank and hand wand, towels, etc., for deconning the equipment. Figures A9 – A10 represent the method described, but with the Laval Camera Trailer, however, the equipment wash-down process remains the same.
F. DEMOBILIZATION

1. During the Finalization (burning) of the DVD (this step is optional and can be performed at a later time).
   a. **Turn OFF Video Overlay and CCU. Never disconnect camera before this step.**
   b. Wash the camera with RainX®, Simple Green®, or equivalent all-purpose cleaner, rinse with water, wipe the camera dry with a microfiber towel to minimize scratches on lens, detach the camera from the cable, and place the camera securely in its case. The ring light may stay connected to camera.
   c. Wipe dry the centralizer and any other wet areas.

2. After DVD is Complete
   a. **Shutdown** the CPU.
   b. **Turn OFF** the UPS.
   c. **Turn OFF** any lights, air condition and/or Heater.
   d. **Power down** the generator.
   e. Reinstall the pressure gauge and start a new test, if applicable, and record the appropriate documentation into the LTM-SN.
   f. Secure and lock the trailer doors; secure and lock the wellhead and the job box if one is on the well pad; note departure in the Video Logging SN.
Appendix B
Operating Procedure and Instructions for the Laval R-Cam 1300 / SC-166 Portable, Borehole Video System:

Figure B1. Rear exterior view of the Camera Trailer with the Laval SC-166 Portable Borehole Camera attached to the boom.

Figure B2. Interior view of the Camera Trailer with the Laval R-cam 1300 Portable Borehole Camera System.

NOTE: The Laval R-Cam 1300 / SC-166 Portable Borehole System is a considered a portable logging system, but the system will be operated while mounted in the Laval Camera Trailer and will use the equipment in the Laval Camera Trailer Electronic Rack (Figures B1 and B2).

A. INITIAL SETUP
1. Prior to Leaving SNL with the Laval Video Logging Camera Trailer (Laval Camera Trailer):
   a. Sync the laptop computer (laptop) to the WIPP data computer. **(Perform this step, and related pressure gauge (PT) steps in this appendix, as required.)**
   b. Log the time into the Long-Term Monitoring Scientific Notebook (LTM-SN).
      NOTE: It is recommended to remove the PT and cable one day prior, so that the well water will have sufficient time to settle.
   c. Fill the gasoline fuel tanks contained in the front of the Laval Camera Trailer, as required.
   d. Fill the wash tank with water in the rear of the Laval Camera Trailer, as required.
   e. Materials needed:
      - Laval R-Cam 1300 Portable Borehole System, mounted in the Laval Camera Trailer (Figure B2)
      - Laval SC-166 borehole camera (camera; Figure B1)
      - Paper towels, clean microfiber towels, and nitrile lab gloves
      - RainX®, Simple Green®, or equivalent all-purpose cleaner, and water
      - DVD (-R) discs and cases/sleeves
      - LTM laptop bag with well keys and well labels
      - Appropriate Personal Protective Equipment (PPE)
      - Video Logging SN, LTMSN and other appropriate SNs
      - Tailgate Safety Briefing, previous video log reports/summaries, and well video-logging Placard
2. Collect Monitoring Equipment

**NOTE:** Perform Steps 2.a – 2.c only if a PT is present in the well. If PT was pulled the day before, use the depth-to-water measurement recorded in the LTM-SN at the time of PT removal and record this in the Video Logging SN.

a. Obtain the water-level sounder for depth-to-water (DTW) measurements.
b. Obtain necessary hand tools.
c. Obtain the water-level sounder/pressure gauge stand; include the cable reel if the PT will be pulled.

3. Arrive at the well pad and conduct the Tailgate Safety Briefing and the weather forecast update. *(An option is to conduct the briefing before departing SNL office.)*

a. In the Video Logging SN, note the arrival time, all personnel, and the activity to be completed.
b. Position the trailer in-line with the wellhead and unlock the wellhead cover.

**NOTE:** Perform Steps 3.c – 3.i only if a PT is present in the well.

c. Using the water-level sounder, make a DTW measurement and record this in the SN.
d. Connect the laptop to the PT.
e. Stop the test on the PT, and record this in the LTM-SN.
f. Download the PT data to the laptop.
g. Pull the PT from the well.
h. When the PT is at the surface, perform a surface check and record in the LTM-SN.
i. Keep the PT safely aside (in the trailer) and start to unpack the video equipment.
j. Position the boom directly over the wellhead.

4. Camera Setup

a. Lift and extend the boom to the desired height to install the borehole camera (Figure B1). If necessary, install the removable sheave to the boom to aid in the travel of the cable (Figure B3). Make sure that all the moving pulley parts and guides on/within the camera boom are not locked and are properly greased with silicon spray or lube.

**NOTE:** Personnel in close proximity to the borehole video system winch and the Camera Trailer boom shall keep hands, loose clothing, and loose personal objects away from exposed moving parts, such as pulleys and sheaves.

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![Figure B3](image1.png) Removable sheave used with the Camera Trailer boom.

![Figure B4](image2.png) Laval R-Cam 1300 Portable Borehole System Control Unit.
5. Position all Control Unit Switches to **OFF** or center positions and REEL CONTROL **SPEED** to **MIN** (Figures B4 and B6).

6. Connect the System Interconnect Cables as per Figure B5. (*Figure B5 depicts the borehole system configured in portable mode, but the figure is also relevant to the borehole system mounted in the Camera Trailer.*)

![Diagram of R-Cam 1300 / SC-166 Portable Borehole System cable interconnection.](image)

**Figure B5.** R-Cam 1300 / SC-166 Portable Borehole System cable interconnection.

7. Ensure All Cables are Connected Between the Laval Camera Trailer LCD monitor (monitor), and DVD recorder (DVDR; Figures B2 and B5).

8. Connect the video cable to the “Video Out” connector on the CU and the other end to the “Video Input” of the DVDR.

9. **Generator Startup**
   a. Using the wall-mounted rocker switch, **PRIME and START** the Laval Camera Trailer generator.
   b. Turn on the APC Uninterruptable Power Supply (UPS) located in the Camera Trailer electronic rack. **Ensure that the UPS, LCD display indicates 100% charge.** If the UPS is not at 100% charge, allow it to fully charge before turning on any other equipment in the electronic rack.
   c. Set the thermostat and start the air conditioner unit or heater unit.

   **NOTE:** Do not start or stop the air conditioning or heater units once video logging has started to avoid generator voltage surges.

10. Connect the 12 VDC cable between the Control Unit (CU) 12 VDC **BATTERY** input and the 12 VDC plug in the rear of the Laval Camera Trailer.

11. Turn on the Laval Camera Trailer monitor, the CU monitor, and the DVDR. (Provided with the system is a Sun Shield for the CU Monitor to assist with bright sunlight and glare when viewing outdoors.)
   a. Select **HDD** or **DVD** recording mode by pressing the appropriate button on the DVDR front
b. Insert a DVD(-R) into the DVDR. Allow sufficient time for the DVDR to “read” the DVD.
c. Tune the DVDR to channel ‘L-1’ using the CHANNEL buttons on the DVDR front panel or remote control.

NOTE: The majority of the time the DVDR will be used in the DVD mode. See the DVDR Owner’s Manual for the operation of the DVDR in HDD mode. The HDD mode is used to temporarily store the video log file in DVDR memory prior to copying (dubbing) it onto a DVD.

Figure B6. Laval R-Cam 1300 / SC-166 Portable Borehole System Control Unit description.

(1) 12 VDC power connection from camera trailer battery
(2) Video Signal output connection to DVDR (or Auxiliary equipment) Video input
(3) 12 VDC power out to DVDR
(4) Video Signal input connection from DVDR (or Auxiliary equipment) Video output
(5) LCD Color Video Monitor storage well
(6) Control function, Video, and Depth Encoder connection to Reel Assembly
(7) Motor power and control connection to Reel Assembly
(8) Camera and Control Unit Power on Indicator Lamp (Optional)
(9) Camera and Control Unit Power ON-OFF Switch
(10) Camera Rotation FORWARD-STOP-REVERSE Switch
(11) Camera DOWN VIEW-SIDE VIEW Selector Switch (not used with SC-166 Camera)
(12) Depth COUNTER RESET Switch (MENU/CLEAR Rocker Switch)
(13) Reel Assembly Motor drive FORWARD-STOP-REVERSE Switch
(14) Reel Assembly Motor drive MIN-MAX Speed Control
(15) Reel Assembly Motor drive Power ON-OFF Switch
(16) Reel Assembly Motor drive power on Indicator (Optional)
B. BOREHOLE CAMERA CONNECTION AND CONTROLS

1. Position the REEL CONTROL ON-OFF Switch to ON (Figures B4 and B6).
2. Position the REEL CONTROL FORWARD-REVERSE Switch to FORWARD and slowly increase the SPEED Control to “Pay-Out” approximately 10 feet of cable while routing it through the Camera Trailer Boom Assembly. Reduce the SPEED Control to MIN and place the FORWARD-REVERSE Switch to OFF (center position).
3. Position the REEL CONTROL ON-OFF Switch to OFF.
4. Ensure the boom is directly over the wellhead.
5. Make sure that all the moving pulley parts and guides on/within the camera boom are not locked and are properly greased with silicon spray or lube.
6. Before connecting the camera to the Cablehead Connector inspect the O-rings in both connectors to be sure they are clear of debris and any contamination. Also check for any wear or damage. The O-rings should also be re-lubricated on a regular basis. Use a NEMA-rated O-ring lubricant.
7. Remove and slide the Cable Head Cover, beveled end first, over and past the Cablehead. Connect the Twist Locking Cablehead Connector to the camera by carefully positioning the connectors together and twisting the lock until seated. Reattach the Cable Head Cover to the top of the camera.
8. Position the CAM CONTROL ON-OFF Switch to ON (Figures B4 and B6).
9. Rewind the excess cable by using the REEL CONTROL functions.
10. Center the camera above the well.

C. RECORDING

1. Tilt the Video
   a. Print a Well Video-logging Placard with the WELL NAME and the DATE.
   b. Place the label in front of the borehole camera for a few seconds when starting video recording.
   c. Push the RECORD button on the DVDR’s front panel or remote control. A RED dot will appear over ‘DVD’ displayed on the DVDR’s front panel’s small, LCD screen.
2. Lower/position the camera in the well, placing the front of the camera at the top of casing (TOC). Press the CAM CONTROL MENU/CLEAR Switch to CLEAR then MENU to reset the depth counter to 000.0f.
3. Begin lowering the camera into the well - note the time in the Video Logging SN.
4. Note the depth of important features, i.e.: wall scale, DTW, perforations, screens, joint anomalies, bottom of hole etc., and give a brief description in the Video Logging SN.
5. When conveying the camera back to the surface, if possible during the return trip, note the depth of bottom & top of slots or perforations (perfs), DTW, and the TOC depths in the Video Logging SN.

D. VIDEO COMPLETION

1. Bring the Borehole Camera Back to the TOC
   a. Again, position the camera, so the front of the camera is at TOC.
   b. If the camera does not return to ‘0000.0 f’ (on screen measurement), note the discrepancy in the Video Logging SN.
2. Stopping Recording and Finalizing the DVD.

   NOTE: If the DVDR counter reaches 1:50, stop recording on the DVDR to provide sufficient space on the DVD for finalization.
   a. Position the CAM CONTROL ON-OFF Switch to OFF. Turn off the CU monitor.
   b. Finalize the DVD using the DVDR remote control.
   c. When ready; push the STOP button (BLACK SQUARE on button) to stop recording.
   d. The RED dot will disappear from over ‘DVD’ displayed on the DVDR’s front panel’s small,
LCD screen. Push the **MENU** button and a menu should appear on the monitor screen.

- Use the **UP/DOWN ARROW** button (next to **MENU** button) to select **DISC EDIT** from the menu, press the **OK** button.
- Use the **UP / DOWN ARROW** button to select **FINALIZE** from the menu, press the **OK** button.
- Use the **UP / DOWN ARROW** button to select **YES** from the menu, press the **OK** button.
- **FINALIZE** DVD appears—Scroll to **YES**. Allow sufficient time for the DVDR to “write” the video file to the DVD.
- When finalizing is complete, the monitor screen will show the Title Menu: **1 L1 SP xx:yy:zz** (recorded time).
- **EJECT** the DVD by pushing the **OPEN/CLOSE** button on the DVD front panel or remote control.

E. **BOREHOLE CAMERA REMOVAL**

When bringing the camera out of well for the last time, wash the cable, the centralizer, and the camera as they come out of the borehole. Use the tennis ball as a squeegee and the rubber well cover, the pressurized wash water tank and hand wand, towels, etc., for deconning the equipment (Figure B7).

![Figure B7. Cleaning the Laval SC-166 borehole camera cable with a tennis ball and rubber well cover.](image)

F. **DEMOBILIZATION**

1. **While Finalizing the DVD**
   - Wash the camera with RainX®, Simple Green®, or equivalent all-purpose cleaner, rinse with water, wipe the camera dry with a microfiber towel to minimize scratches on lens, detach the camera from the cable, and place the camera securely in its case.
   - Wipe dry any other wet areas.
   - Remove the sheave (if used) and secure the boom.

2. **After Finalizing is Complete**
   - Label the DVD include the **WELL ID**, the **DATE**.
   - Turn **OFF** the monitor, the DVDR, air condition and/or heater and the UPC.
   - Power down the generator.
   - Reinstall the pressure gauge and start a new test, if this is appropriate, and record the appropriate documentation into the LTM-SN.
   - Secure the trailer doors; secure and lock the wellhead and the job box if one is on the well pad; note departure in the Video Logging SN.
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