Melter Viewing System for Liquid-Fed Ceramic Melters

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SUMMARY

Melter viewing systems are an integral component of the monitoring and control systems for liquid-fed ceramic melters. The Pacific Northwest Laboratory (PNL) has designed cameras for use with glass melters at PNL, the Hanford Waste Vitrification Plant (HWVP), and West Valley Demonstration Project (WVDP). This report is a compilation of these designs. Operating experiences with one camera designed for the PNL melter are discussed.

The cameras have been designed to provide images of the melter interiors while protecting the optical components from the harsh environment of corrosive chemicals, high temperatures, and high radiation fields. Critical components are fabricated of corrosion-resistant and radiation-hardened materials. Two separate cooling-air paths are used in all the designs to maintain camera temperatures within an acceptable temperature range. The electronic components of the cameras are placed outside the melter to further protect them.

A camera has been fabricated and tested on the High-Bay Ceramic Melter (HBCM) and the Pilot-Scale Ceramic Melter (PSCM) at PNL. The camera proved to be an effective tool for monitoring the cold cap formed as the feed pool developed on the molten glass surface and for observing the physical condition of the melter. Originally, the camera was built to operate using the visible light spectrum in the melter. It was later modified to operate using the infrared (IR) spectrum. In either configuration, the picture quality decreases as the size of the cold cap increases. Large cold caps cover the molten glass, reducing the amount of visible light and reducing the plenum temperatures below 600°C. This temperature corresponds to the lowest level of blackbody radiation to which the video tube is sensitive.

The camera has been tested in melter environments for about 1900 h. The camera has withstood mechanical shocks and vibrations. The cooling system in the camera has proved effective in maintaining the optical and electronic components within acceptable temperature ranges.

A new camera has been designed with improvements that evolved from the operating experiences with the first camera. Most of the optical components have been moved out of the harsh environment of the melter plenum. This

reconfiguration results in a simpler, easier to repair camera housing. The camera housing is also more upright than previous designs to reduce interference with other equipment on the melter.

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ACRONYMS

ADS	Air-Displacement Slurry
FRG	Federal Republic of Germany
HBCM	High-Bay Ceramic Melter
HWVP	Hanford Waste Vitrification Plant
IR	infrared
LFCM	Liquid-Fed Ceramic Melter
NTSC	National Television System Committee
NWTP	Nuclear Waste Treatment Program
PNL	Pacific Northwest Laboratory
PSCM	Pilot-Scale Ceramic Melter
RGB	red green blue
RLFCM	Radioactive Liquid-Fed Ceramic Melter
SCFM	Standard Cubic Feet Per Minute
SODA	Small Optical Design and Analysis
SRL	Savannah River Laboratory
WVDP	West Valley Demonstration Project

INTRODUCTION

Liquid-fed ceramic melters (LFCM) are being developed for immobilizing radioactive liquid wastes in a glass matrix. The Nuclear Waste Treatment Program (NWTP) and its predecessors at the Pacific Northwest Laboratory (PNL) have the responsibility to develop the technology necessary to implement this process for the treatment of radioactive wastes. A melter viewing system is an integral component of the control system for the LFCM process.

In the LFCM process, a slurry of the radioactive wastes and finely crushed glass is poured onto a pool of molten glass in the melter. The liquids boil off and the chemicals decompose to their oxides before being absorbed by the molten glass. At sufficiently large feed rates, a "cold cap" forms on the surface of the glass. Most of the decomposition reactions take place in this cold cap. The cold cap is advantageous because it reduces the volatilization of species from the hot glass, and it maximizes the vitrification processing rate. However, if the cold cap becomes too large, the melting process becomes unstable. The cold cap may bridge across the walls of the melter such that the cold cap may lose contact with the molten glass, thereby reducing heat transfer and slowing the processing rate. Pressurizations are also more vigorous and frequent. Thus it is important to optimize the cold cap size to maximize the production rate without extending into potentially unstable operating conditions.

Another operating condition of concern is the formation of glass foam. This foam increases the volume of material in the melter to levels that could damage equipment and insulates the cold cap from the molten glass, thus reducing the processing rate.

The size and condition of the cold cap, the presence of foam, and the general physical condition of the melter have historically been determined via visual observation. The nonradioactive melters at PNL have view ports that allow the operators to look directly into the melter. Melters for processing radioactive wastes cannot be viewed directly because of the need to place the melters in shielded facilities. Therefore, remote viewing techniques are needed to look into the melter cavity and observe the condition of the cold cap and the interior melter components. Other instrumentation

was evaluated in a previous study to determine whether it could provide the same information as viewing the glass surface but did not prove to be as explicit (Barnes, Westsik, and Wise 1985; Westsik et al. 1985). The Radioactive Liquid-Fed Ceramic Melter (RLFCM) at PNL was operated successfully for about 2-1/2 years without a melter viewing system. While visual may not be necessary on a continuous basis, it does provide an excellent method to verify conditions within the melter and will enhance control and perhaps increase efficient melter operation.

This report discusses the designs of the melter viewing systems used at PNL and the designs prepared by PNL for WVDP and HWVP. Operating experiences with the PNL system are presented. Based upon these operating experiences, a new camera design has been prepared for use at PNL.

CURRENT CAMERA DESIGNS

Melter viewing systems are designed to provide an image of most of the melter surface while protecting the necessary lenses, mirrors, and electronics from the harsh environment of corrosive chemicals, high temperatures, and high radiation fields. The optical components and their housing are referred to here as the "camera." Savannah River Laboratory (SRL) designed the first camera system for remote viewing of the melter surface (Heckendorn 1983, 1986). Pacific Northwest Laboratory incorporated features of the SRL design into cameras built for the High-Bay Ceramic Melter (HBCM) and the Pilot-Scale Ceramic Melter (PSCM) and for the RLFCM. The Laboratory is also designing cameras for use at WVDP and at HWVP.

PNL DESIGNS

The first camera built at PNL was designed and fabricated for the HWVP (Siemens et al. 1985). This camera was tested and evaluated on the HBCM and PSCM melters. This basic camera design was then modified for the RLFCM to incorporate features necessary for the remote, radioactive environment.

HBCM/PSCM Camera

Figure 1 shows a schematic of the HBCM/PSCM camera. The camera was designed to be installed in a corner of the melter. Because the camera was to be in a vertical nozzle, the objective lenses were offset 30 degrees from vertical to look down and across the molten glass surface. Outside the melter, the optical path bends 90 degrees so that the video tube is not in the direct path of radiation from the glass. Detailed drawings of the camera are shown in Appendix A.

Two air streams are used to cool the camera. The first enters the camera body behind the video tube. Cooling the video tube is important because the electronics are particularly susceptible to heat. After flowing past the video tube, the air flows through holes in the iris/filter holder, down through the center optic-path tube, across the mirrors in the camera nose, and along the wide-angle lens housing. The air then flows back up in the annulus between the optic-path tube and the outer housing and exhausts into the cell. Design

FIGURE 1. Schematic of HBCM/PSCM Camera

calculations show this flow pattern keeps the lens assembly cooler than with the air flow reversed. The second air stream flows through flexible tubing to the face of the wide-angle lens and out into the melter through the aperture. This flow path keeps the face of the lens cool and helps sweep off the gas and particulates away from the camera nose. It is important that this cooling air be filtered to remove oils and particulates that could damage the optics and electronics of the camera.

During the initial testing, particulates and condensates obscured the aperture of the camera. A steam jet that blows across the aperture was therefore added. Short (<10-second) blasts of steam once a day proved effective in keeping the aperture clear. Because the steam blasts caused pressurization of the melter, one-second blasts were recommended (Siemens et al. 1985). The steam line was not needed during PSCM runs 21 and 22.

The camera has been designed to be mounted vertically in one corner of the melter and to view the surface of the melt at a distance of about 46 cm. Since the surface to be viewed is somewhat larger than 60 cm x 120 cm, the camera objective must have a very large field of view. An eyepiece-type lens with a 70-degree field of view and a 16-mm focal length was chosen. The image formed by this lens is relayed to the sensitive surface of the video tube using an achromat with a focal length of 22.00 cm, located about 26.2 cm in front of the video-tube sensitive surface.

Because the PSCM and HBCM melters do not process radioactive materials, a standard commercial lens could be used for the objective lens. However, the cement used with one pair of elements in this commercial lens deteriorates when the lens becomes too hot. To avoid the resulting deterioration of the image, this lens must first be taken apart and the cement removed. The lens can then be reassembled without cement.

Originally, the camera was designed to operate using the visible light spectrum. This was possible when the plenum heaters (as used at SRL) or the exposed molten glass would illuminate the melter cavity. The camera included a filter to remove the near-IR light and an iris assembly to reduce the intensity of the visible light. The visible spectrum is of limited value, however, when there are no plenum heaters and when the cold cap covers the

glass surface. Therefore, the iris and visible-light-transmitting filter were replaced with an IR-transmitting filter. Figure 2 shows the response of the video tube, the light transmitted by the two types of filters, and the radiation emitted by a blackbody at temperatures expected in a glass melter (Siegel and Howell 1981).

RLFCM Camera

The RLFCM camera is very similar in design to the HBCM/PSCM camera. The camera is intended to be placed in a nozzle in a corner of the melter.

As shown in Figure 3, the RLFCM camera has the same "L" shape as the cold camera. However, the lenses and mirrors in the nose are rotated 180

FIGURE 2. Spectral Response of Video Tube and Emittance of Blackbodies at Typical Melter Temperatures

FIGURE 3. Schematic of RLFCM Camera

degrees. Lead shielding is placed inside the housing to protect the sensitive video tube. The cooling-air paths are the same as those of the HBCM/PSCM camera. Detailed drawings of the RLFCM camera are included in Appendix B.

The optics for the camera have been modified for the remote, radioactive application. The upper mirror has been remounted to allow adjustments with a manipulator. A three-element, air-spaced objective lens assembly replaces the commercial lens of the HBCM/PSCM camera. The lens has the same focal length and 70-degree field of view. The first lens element is fused quartz to withstand the heat and radiation in the melter. The other two lens elements are made from Schott^(a) BK-7-G-18 glass, which is a cerium-stabilized glass that is resistant to radiation damage.

The lenses for the RLFCM, WVDP, and the new PNL cameras were designed using a computer program called SODA (Small Optical Design and Analysis).^(b) The designer provides inputs of the indices of refraction, lens-surface location, approximate lens-surface curvature, and the size and location of the entrance pupil. The glasses to be used and the wavelengths to be considered in the design are specified in terms of the indices of refraction used. The designer also prescribes the relative importance of the aberrations to be corrected. These aberrations include spherical aberrations, coma, astigmatism, distortion, Petzval curvature, and longitudinal and lateral color.

The outputs of the program are the optimum surface curvatures and thicknesses for each lens component. For the cameras designed at PNL, the optics were optimized as a complete system. Thus, aberrations of the objective lens assembly are reduced by the relay lens assembly. Individual lens assemblies are not individually optimized, a technique that would not result in the best system design.

Electronics

A Matsushita Newvicon S4119^(c) extended near-IR video-camera tube is used in both the HBCM/PSCM and RLFCM systems. This tube is sensitive to spectral

(a) Trademark of Schott Glaswerke, Mainz, West Germany.

(b) Copyright 1985 by Donald W. Small.

(c) Trademark of Matsushita Electric Corp. of America, Secaucus, New Jersey.

energy extending from 0.4 μm to 0.95 μm (see Figure 2). The video tube has been shown to withstand radiation doses to 3×10^8 R. Improved image quality is obtained by restricting the spectral range to either the visible or the IR portion of the spectrum. Because the molten glass surface is viewed in its own radiation, somewhat cooler surfaces can be seen using the IR spectrum extending from 700 nm to 950 nm. Therefore, an optical filter is used between the relay lens and the video tube to remove the visible light spectrum. A separate remote control unit isolates much of the electronics from the radiation field.

Signals from the control unit can then be viewed directly on a video monitor, recorded on video tape, or further processed. The HBCM/PSCM melter-viewing system includes a gray-scale-to-color converter that classifies the black and white signal into eight brightness bands. When processing an IR image, the bands can be calibrated to span-defined temperature ranges. The areas of the bands can also be determined and displayed on a digital meter. To aid in calibrating the image analyzer, we replaced the factory knobs with 0-100 turn dials. An RGB (red, green, blue) output from the image analyzer is displayed on an RGB monitor either as a black and white picture or in color, with the colors indicating specific brightness bands. The RLFCM system has a gray-scale-to-color converter but does not include the image-analyzing capabilities.

To record the RGB color pictures on video tape, the RGB outputs must first pass through a color encoder which converts the signal to the standard National Television System Committee (NTSC) format. The signals are then recorded on a video cassette recorder, which can record up to one hour of video on 3/4-inch tapes. If it is necessary to document an entire melter run, recording in the VHS format^(a) with longer and cheaper tapes should be considered.

(a) Trademark of Victor of Japan, Ltd., Yokohama City, Japan.

WVDP CAMERA DESIGN

A melter viewing system has also been designed for use in WVDP. The design places the video camera outside the melter cell in a region shielded from radiation (See Figure 4). The video camera can be serviced or replaced without exposure to high radiation levels. To place the camera outside the cell, two additional relay lenses and two mirrors were used. These were designed to fit into a shield plug with an offset optical path. Aside from this shield plug and its associated optics, the remainder of the periscope is essentially the same design as that used for the RLFCM. The prescriptions for the lenses have been changed, however, to optimize to the dimensions of the WVDP cell. The conceptual design for the camera is shown in Appendix C.

HWVP CAMERA DESIGN

The camera designed for the HWVP is very similar to the design for the RLFCM camera at PNL. They differ primarily in the location and type of connectors for the electrical, cooling air, and steam services. The conceptual design for the camera is shown in Appendix D.

FIGURE 4. Schematic of WVDP Camera

FIGURE 1. SCHEMATIC OF MAIN CIRCLES

OPERATING EXPERIENCE

The melter viewing system was developed initially to operate using the visible light spectrum. The camera was later modified to operate using the near-IR spectrum. Operating experience with both configurations is discussed below.

VISIBLE LIGHT CONFIGURATION

Initial development of the HBCM/PSCM camera has been reported previously by Siemens et al. (1985) and is summarized here. During the development period, the steam jet was added to facilitate removal of splashes and condensates that were obscuring the aperture in the camera nose. The iris and IR filter were inserted into the optical path to improve the clarity of pictures displayed. The gray-scale-to-color converter was employed to further improve the picture clarity. The camera was shown to withstand the vibrations and shocks of bumping into objects during installation. To remove distortion in the pictures caused by the power cables supplying power to the melter, an isolation transformer was inserted into the power supply line to the camera and monitor. Cooling air maintained temperatures near the nose of the camera at 127°C during idling in the HBCM. Flow rates were 18 SCFM through the camera body and 1.7 SCFM through the camera aperture.

The camera was installed in the HBCM for 1155 h in a long-term test of the optics and camera housing. No deterioration of camera performance was detected.

The camera was then used during the 320 h of the PSCM-19 melter experiment in August 1984 (Burkholder, Jarrett, and Minor 1985). All components of the system worked well. Cooling air at 3 SCFM was sufficient to keep the measured camera temperature below 100°C. Steam cleaning kept the aperture free of visible obstructions. Picture quality was dependent upon the cold cap size; larger cold caps decreased illumination, which resulted in poorer picture quality.

IR CAMERA CONFIGURATION

Following the melter test designated PSCM-19, the camera was modified to utilize the near-IR rather than the visible light spectrum. The iris and IR filter were replaced by a visible light filter with a cutoff of $0.7\ \mu\text{m}$. The camera was then used during portions of melter runs PSCM-21 and PSCM-22 (Burkholder and Jarrett 1986; Burkholder, Jarrett, and Minor 1986).

Installation of the IR camera for the PSCM-21 run was delayed because of difficulties in cooling the lens-and-mirror portion of the camera that extends into the melter plenum. The lack of cooling caused the mirrors and one of the lens elements to break. Once an air leak was plugged and the broken optical components were replaced, the camera worked well. The camera was installed in the melter for a total of 311 h. Temperatures measured near the lower mirrors were as high as 255°C during idling and as low as 77°C during melter operation.

For the PSCM-21 run, the camera was rotated to look at the southwest corner of the melter beneath the viewport such that the corner opposite the corner visible from the viewport could be observed (Figure 5). Video tapes were made of growth and burnoff of the cold cap, overfeeding, and the early stages of foaming. Figures 6 through 14 show photographs taken from the video tapes recorded during PSCM-21. The photos include large portions of the melter walls rather than the glass/cold cap surface. Only a quarter to a third of the melt surface is visible because the horizontal part of the camera extended between the feed nozzle and the bubbler tube (see Figure 5) such that the camera could not be rotated to look at more of the melt surface. From the perspectives of the camera and viewport, drifting of the cold cap along the melt surface could be observed. Neither the view from the camera nor from the viewport gives an accurate indication of the cold cap coverage in those areas that were not visible. It will therefore be difficult to use the IR camera to obtain quantitative data on the growth and consumption of the cold cap unless the entire melt surface can be viewed.

Figure 6 shows the melter interior at about 13:45 on June 6, 1985. The bubbler probe is clearly visible at the lower left; the feed nozzle is at the upper right, and the south electrode and glass thermowell are at the lower right. Hotter regions in general appear brighter in the photo. However,

FIGURE 5. Location of Melter Instrumentation During PSCM-21

FIGURE 6. Melter Interior Showing Bubbler Probe, Feed Nozzle South Electrode, and Thermowell.

FIGURE 7. Melter Interior Seven Minutes After Figure 6. Note the absence of the pour stream at the tip of the nozzle.

FIGURE 8. Gray-Scale Conversion of Figure 6

FIGURE 9. Melter Interior During Overfeeding

FIGURE 10. Melter Interior 2 Minutes After Feed Turned Off

FIGURE 11. Melter Interior 12 Minutes After Feed Turned Off

FIGURE 12. Melter Interior 22 Minutes After Feed Turned Off

FIGURE 13. Melter Interior 32 Minutes After Feed Turned Off

FIGURE 14. Melter Interior 42 Minutes After Feed Turned Off

many surfaces reflect the light from the exposed hot glass, making the surfaces appear hotter than they really are. Thus, the feed stream pouring from the feed nozzle appears as a bright line extending beyond the tip of the feed nozzle, and the bubbles from the boiling slurry appear as bright circles on the cold cap surface. Figure 7 was taken about seven minutes after Figure 6 when the air-displacement slurry (ADS) pump was in its fill cycle such that there is no feed stream visible at the tip of the feed nozzle.

Figure 8 shows the effect of the gray-scale-to-color converter on the image taken 2 or 3 seconds after Figure 6. (Note that Figure 8 is a black and white photograph of this conversion.) Whereas the conversion from black and white to the color band is reported to improve the picture quality for the visible light camera configuration, the gray-scale-to-color conversion appears to result in a loss of detail when using the near-IR spectrum (Siemens et al. 1985).

Figure 9 shows the melter during an intentional period of overfeeding at about 22:20 on June 8, 1985. The interior is very dark except for several vents in the cold cap. The light streaks emanating from the top of the photo are the paths taken by glass particles emitted by a vent out of the field of view. Details of the feed nozzle are blurred because of glass fibers adhering to the nozzle that are waving in the off-gas flow during the timed exposure required to take the picture.

Figures 10 through 14 are a sequence of photos showing the burnoff of the cold cap when the feed was stopped at 23:30 on June 8, 1985. Figure 10 was taken two minutes after the feed was turned off. The remaining photos were taken at ten-minute intervals thereafter.

Note that in all eight photographs there is a glow between the south electrode and the south wall of the melter. It appears that the hot glass has gotten between the electrode and the wall, and thermal radiation is emanating from the gap between the two melter components. Indeed, when the PSCM was disassembled following PSCM-22, a gap of at least 5 cm was found between the electrode and the wall (Koegler 1987). Thus, the camera can be used to inspect the physical condition of the melter.

Testing of the IR camera during PSCM-22 was plagued with a number of problems. The camera was not installed until the final week of the run and was used for only 96 h. Before the run started, the nose piece that protects the lenses and mirrors which extend into the melter plenum was found to have corroded to the extent that cooling to the lenses was lost. This corrosion necessitated refabricating several parts of the camera housing. Installation was further delayed by a short circuit in the electronics of the camera itself. A buildup of glass and corrosion products in the melter-lid nozzle sleeve, through which the camera must slide to look into the melter, had to be removed before the camera could finally be installed. Picture quality was not as good as with previous melter runs. This loss of quality was probably a result of 1) changes in critical distances within the optical path caused by the refabrication of the camera housing, and 2) reinstallation of the surface mirrors backwards so that the image was reflecting off multiple interfaces.

The RLFCM camera has not been used to date. The dose rates generated by the high cesium and strontium levels in the glasses being produced for the Federal Republic of Germany (FRG) are of the order of 5×10^5 R/h. This is approximately 50 times higher than the dose rates expected for the wastes at WVDP. At the higher dose rates of the FRG glasses, the video tube would have an expected lifetime of less than 1000 h.

While both the visible and the IR-spectrum configurations appear to give good pictures of the melter interior when there is little or no cold cap, neither camera configuration provides much detail when the cold cap is large (Figure 10 for example). This is a result of the sensitive range of the video tube in the camera. Referring back to Figure 2, the video tube is sensitive to thermal radiation between 400 nm and 950 nm. As the blackbody radiation curves show, temperatures must exceed 600°C before the thermal radiation can be seen by the video tube. As Figure 15 shows, plenum temperatures can drop below 600°C with as little as 30 to 40% cold cap coverage and below 500°C with 100% cold cap coverage. With 30 to 40% coverage, there is still sufficient molten glass exposed to illuminate the melter. However, at 100% coverage, there is no illumination other than that due to venting; the melter will appear black even in the IR configuration. The lack of illumination is itself an

FIGURE 15. Plenum Temperatures for Run PSCM-16

indication that overfeeding is being approached. The lack of detail is more of a problem when trying to develop models of the cold cap, when, for example, it is important to distinguish between regions of boiling and dried feed.

Thermal imaging systems are available that are sensitive to the 3-6 μm and 8-12 μm regions. However, it is very difficult if not impossible to design a wide-angle periscope to relay the image of the melt surface to these systems. Furthermore, liquid nitrogen is required as a coolant in some models, and the scan rates and resolution are poor in others.

NEW PNL CAMERA DESIGN

Operating experiences with the HBCM/PSCM camera led to some design improvements to be implemented in a new PNL camera. First, although the cooling air flow pattern provided sufficient cooling of the camera, we still wanted to move as many of the optical components as possible away from the hot region of the camera that is directly exposed to the melter. Second, we wanted a more upright camera such that could be rotated without interfering with other equipment on the melter. Third, we wanted a camera that could be easily and rapidly repaired.

Critical to achieving these design goals was a modification to the PSCM lid. Previously, all process nozzles were oriented vertically or horizontally. During the rebuilding of the PSCM, a special nozzle with an angle 30 degrees from vertical was placed in the northwest corner of the melter lid (Koegler 1987). We recognize that vertical nozzles are preferred in the hot cells, but it is possible to design devices that could be used in the hot cells with manipulators to install the camera in an angled nozzle. The camera could also be placed vertically on a flange near the center of the melter.

In all of the previous camera designs the optical axis is vertical as it penetrates the melter and is then deflected 30 degrees from vertical in order to view as much of the glass surface as possible from one corner of the melter. There is no need for this offset in the new PNL design because of the 30-degree nozzle; therefore, the design could be simplified (see Figure 16 and Appendix E). Two mirrors and a complex offset mounting structure are eliminated from the nose of the camera. The outer casing of the camera that extends through the refractory is made of Inconel 690^(a) to resist corrosion. The nose of the camera is a thicker and simpler structure that should be less subject to corrosion. The steam jet has been retained to keep the aperture clear of obstructions. Servicing, if required, will be easier because the optical system is more readily removed from the outer enclosure.

(a) Inconel is a trademark of the Huntington Alloys Corporation, Huntington, West Virginia.

FIGURE 16. New PNL Camera Design

The cooling-air flow patterns are retained in the new camera design. The main cooling air flows past the video tube, through the camera body, past the wide-angle lens, and back out into the atmosphere. A second, smaller stream of air flows past the face of the wide-angle lens, through a 0.152-cm-diameter aperture into the melter plenum. The noses of the HBCM/PSCM and RLFCM cameras must extend into the melter plenum to view the melter surface. The new PNL camera is designed to be recessed into the refractory, which should also help keep the camera cool.

The optical requirements for the new PNL periscope camera are quite similar to those for the RLFCM camera. Although the viewing distance in the PNL camera is 91 cm rather than 46 cm, the optical design for both cameras consists of a wide-angle objective lens, a relay lens, a filter and the video system. Two mirrors are used to offset the optical axis outside the melter in order to remove the video camera from the direct radiation beam.

The objective lens assembly consists of three elements. The first element is the primary image former; the other two elements direct the light into the relay lens. The first or front element is also the smallest element and the one most directly exposed to the heat, radiation, and spatter of the melt. It is fabricated of synthetic fused silica, which resists damage resulting from thermal shock and resists darkening resulting from radiation. Lenses 2 and 3 are made of Schott BK-7-G-18 radiation stabilized glass. The second and third lens elements in the set are mounted together with the front lens in a stainless steel housing, which is cooled by air that flows down the innermost tube and back up through a concentric tube of larger diameter.

Light from the image formed by the objective lens assembly is transmitted up the innermost tube to a pair of mirrors outside of the melter. Both mirrors can be adjusted to align the optical beam with the relay lens and video camera.

A relay lens reforms an image on the sensitive surface of the camera tube. The relay lens consists of two elements, one made of Schott BK-7-G-18 and the other made of Schott F-2-G-12. Both lens materials are stabilized against darkening that results from nuclear radiation. This combination of

glasses is used to achromatize the lens system for three wavelengths in the visible spectrum. The objective and relay lenses were designed as one group to obtain optimum performance.

An optical filter is mounted between the relay lens and the video camera to limit the spectrum to either the visible or the near-IR portion of the spectrum. Typically, the visible transmitting filter cuts off at 700 nm. When the IR filter is used, this effective pass band is limited to the region between 700 nm and 900 nm. This is a relatively narrow band, and no effort was made to optimize or achromatize the optics for this band.

REFERENCES

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- Siegel, R., and J. R. Howell. 1981. Thermal Radiation Heat Transfer Hemisphere Publishing Corporation, Washington DC.
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APPENDIX A

DETAILED DRAWINGS OF THE HBCM/PSCM CAMERA

GENERAL NOTES

(UNLESS OTHERWISE SPECIFIED)

1. DIMENSIONS & TOLERANCES IN ACCORDANCE WITH ANSI Y14.5
2. TOLERANCES
FRACTIONS $\pm .005$
DECIMALS $\pm .005$
ANGLES $\pm 1^\circ$
3. ALL MACHINED SURFACES $\sqrt{10}$ IN ACCORDANCE WITH ANSI A4.1
4. BREAK ALL SHARP EDGES RADIUS .005
5. ABBREVIATIONS ARE IN ACCORDANCE WITH ANSI Y14.1
6. ALL WELDING PER AWS D1.1
7. NEVER SEIZE ALL THREADS PRIOR TO ASSY
8. FABRICATOR SHALL ASSURE ALIGNMENT & SMOOTH OPERATION OF ALL MOVING PARTS

ASSEMBLY

A.3

DETAIL VII
SCALE 1/2"=1'-0"

MATL 304 SS

NOTE: FABRICATOR SHALL PROVIDE FLUSH FIT WITH CHANNEL IN AREA OF DET 1 & 2 INSTALLING IN DET 1 & 2 AND MAINTAIN 20° DIA AS INDICATED ON ASSY (SHEET 1)

DETAIL VIII
SCALE 1/2"=1'-0"

MATL 304 SS

DETAIL IX
SCALE 1/2"=1'-0"

MATL 304 SS

DETAIL X
SCALE 1/2"=1'-0"

MATL 304 SS

NOTE: FABRICATOR SHALL VERIFY LENS THICKNESS AT POINT OF CONTACT & LOCATE GROOVE TO ASSURE TIGHT SEATING OF LENS

DETAIL XI
SCALE 1/2"=1'-0"

MATL 304 SS

NOTE: FABRICATOR SHALL PROVIDE FLUSH FIT WITH CHANNEL IN AREA OF DET 1 & 2 INSTALLING IN DET 1 & 2 AND MAINTAIN 20° DIA AS INDICATED ON ASSY (SHEET 1)

DETAIL XII
SCALE 1/2"=1'-0"

MATL 304 SS

DETAIL XIII
SCALE 1/2"=1'-0"

MATL 304 SS

DETAIL XIV
SCALE 1/2"=1'-0"

MATL 304 SS

DETAIL XV
SCALE 1/2"=1'-0"

MATL 304 SS

2ND ISSUE 7-20-04

100% IOT

U. S. Department of Energy	
National Operations Office	
PACIFIC NORTHWEST LABORATORY	
OPERATED BY BATTelle PACIFIC NORTHWEST	
MELTER VIEWING SYSTEM	
PRECONCEPTUAL VERIFICATION	
MISC. DETAILS	
DRAWING NO. 3A-3-2006	
DATE 7-20-04	
BY 1015	
CHECKED 1015	
APPROVED 1015	
REVISIONS	
1. 7-20-04	
2. 7-20-04	
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15. 7-20-04	
16. 7-20-04	
17. 7-20-04	
18. 7-20-04	
19. 7-20-04	
20. 7-20-04	

APPENDIX B

DETAILED DRAWINGS OF THE RLFCM CAMERA

九

- 10

(UNLESS OTHERWISE SPECIFIED)

FRACTIONS - $\pm \frac{1}{2}$

DECIMALS = .22 = 2.01

... 5.003

ANGLES: $50^{\circ}, 30'$

6. ALL DIMENSIONS ARE IN INCHES.

2 REMOVE ALL SURBS & CRACK ALL JUNK EDGES.

DOI: 10.1002/anie.200500000

54015545 3-783

UQP[®] 1093

U. S. Department Of Energy
Nuclear Operations Office
PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

MELTER VIEWING
SYSTEM

WASTE TREATMENT PROJECT (WTP)

124-2000	10000
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54-2-10753 111

3X3-19755 1717

DETAIL II
- 100 -

DETAIL I
4476 - 100 SERIES SET

PARTS LIST & GENERAL NOTES LOCATED ON SHEET 1

3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041

U. S. Department Of Energy
Richard G. Anderson, Chief
PACIFIC NORTHWEST LABORATORY
OPERATOR OF BATTELLE RESEARCH INSTITUTE
MELTER VIEWING
SYSTEM
DETAILS

WATER TREATMENT PROJECT - (P)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398</
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SK. 3. 19753 1211

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1

[illegible]

DETAIL V
MAYL 380 SERIES JSP

4 END CLOSURE
NOTE - 46-6046 250 DIA HOLES
(SEE DETAIL III AFTER
WELDING DETAIL II)

DETAIL IV
MATERIAL - NICKEL ALLOY N-200
(ASTM B 163)
A

4-7181 NO BRANCHES LOCATED ON THIS DATE

109

U.S. Department of Energy Pacific Northwest Laboratory 900 North 8th Street, Richland, WA 99352	
MELTER VIEWING SYSTEM DETAILS	
DATE: 10/15/73 TIME: 10:00 AM BY: J. L. ... FOR: ... PROJECT: ... DRAWING NO.: ... SHEET NO.: ...

[illegible]

17 UPPER LENS RETAINER
DATE: 88438

13 LOWER LENS RETAINER
MATERIAL - BRASS

15 CENTER LENS RETAINER
MATERIAL: 304SS

11 LENS HOUSING
MAYL - 300 448168 JST

(12) LOWER LENS
NOTE: "SUPERSON" QUARTZ
MFG BY HARRIS - AMERSON
INC. OR EQUAL
NOTE: THIS PART IS STOWED ASSEMBLED

14 CENTER LENS
MATERIAL: "NOIR" MAG OF
QUARTZ OPTICAL GLASS
CD 37 24446
NOTE: THIS PART CUSTOMER SPECIFIED

16 UPPER LENS
WAF - Same as the 1st
WAF - This is the 2nd of the 2nd

4875 117 4 6245000 40711 204710 24 5-017 1

JAN 15 1966 JQP 1093

U. S. Department Of Energy
Nuclear Operations Div.
PAFIC NORTHWEST LABORATORY
OPERATED BY BETHLEHEM NUCLEAR INDUSTRIES

MELTER VIEWING
SYSTEM
DETAILS

- AS TR TREATMENT PROJECT (WTR)
324.866 (WTR) 23333

SK-3-19753 7 11

B.8

19 UPPER LENS HOLDER
MATEL: 6061-T6 AL
FINISH: BLACK ANODIZE

21 JAM SCREW
MATEL: BRASS

63 JAM NUT
MATEL: 505 SERIES SET

60 APERTURE DISC
MATEL: 6061-T6 ALUMINUM
FINISH: BLACK ANODIZE

61 FLAT MIRROR
MATEL: 6061-T6 AL
FINISH: BLACK ANODIZE

63 SPACER
MATEL: 505 SERIES SET

62 TOP LENSES
NOTES: "NB 88" & "NB 86" GLASS
ARE MFGD BY OHARA OPTICAL
GLASS INC
TOTAL HARD-TO-GETTER SUPPLIES

18 MIRROR RETAINING SPRING

PARTS LIST & GENERAL NOTES LOCATED ON SHEET 1

U.S. DEPARTMENT OF ENERGY
PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTELLE MEMORIAL INSTITUTE

MELTER VIEWING
SYSTEM
DETAILS

WASTE TREATMENT PROJECT (WTP)

SK 3-19753 6-11

[illegible][illegible]

Technical drawing of a rectangular plate with dimensions and hole specifications. The drawing includes a top view and a side view. The top view shows a rectangle with overall dimensions of 23 1/2 inches in length and 5 1/4 inches in width. There are four circular holes along the centerline. The distance from the left edge to the first hole is 6 inches. The distance between the first and second hole is 11 1/2 inches. The distance between the third and fourth hole is 2 1/4 inches. The distance from the fourth hole to the right edge is 1 3/4 inches. The side view shows a rectangle with a width of 2 1/4 inches. Annotations include: "2 DIA. 4 HOLES (PH26) 2 HOLES (PH27)" pointing to the first two holes, "2 DIA. 4 HOLES (PH26) 2 HOLES (PH27)" pointing to the last two holes, and "OMIT THIS HOLE FOR PH27" pointing to the third hole. A note "2 DIA. 4 HOLES (PH26) 2 HOLES (PH27)" is also present at the bottom left.

27 SIDE SHIELD (LH)
SAME AS ABOVE EXCEPT DIFF
HOLE AS SHOWN

[illegible]

1981 1093

U. S. Department Of Energy

PACIFIC NORTHWEST LABORATORY

PREPARED BY GATFALLS MEDICAL ASSISTANT

MELTER VIEWING

SYSTEM

DETAILS

WASTE TREATMENT PROJECT (WTP)

224-44246 2-8-59

SK-3-19753 1911

1990

30 COVER GASKET
MATL - FIBERFRAX STOP PAPER
1/8 NOMINAL THICKNESS
AS MFD BY CARBORUNDUM
CO. OR EQUAL

32 TUBE GASKET
MATL - SAME AS PH 30

31 LENS GASKET
MATL - FIBERFRAX STOP PAPER
1/8 NOMINAL THICKNESS
AS MFD BY CARBORUNDUM
CO. OR EQUAL

29 SEAL PLATE
MATL - 16 GA 300 SERIES
SET SHEET

58 MOUNT GASKET
MATL - FIBERFRAX STOP PAPER
1/8 NOMINAL THICKNESS AS
MFD BY CARBORUNDUM CO
OR EQUAL

PARTS LIST & GENERAL NOTES LOCATED ON SHEET 1

1ST ISSUE 9 APR 62 JOP # 1093

U. S. Department of Energy Isotopes Operations Office		PACIFIC NORTHWEST LABORATORY OPERATED BY BATTelle MEMPHIS, TENNESSEE	
PROJECT: MELTER VIEWING SYSTEM DETAILS		TASK: ASSESSMENT OF PROJECT, (MTR)	
SUBJECT: MELTER VIEWING SYSTEM DETAILS		TASK: MELTER VIEWING SYSTEM DETAILS	
DATE: 3-1975		DRAWN BY: JOP # 1093	
CHECKED BY: JOP # 1093		APPROVED BY: JOP # 1093	
REVISIONS:		REVISIONS:	
1. 3-1975		1. 3-1975	
2. 3-1975		2. 3-1975	
3. 3-1975		3. 3-1975	
4. 3-1975		4. 3-1975	
 	

APPENDIX C

CONCEPTUAL DESIGN FOR THE WVDP CAMERA

PLAN
MELTER VIEWING SYSTEM

SECTION A-A

SECTION B-B

CONCEPTUAL

U.S. Department of Energy	
PACIFIC NORTHWEST LABORATORY	
OPERATED BY BENTLEY ENGINEERING INSTITUTE	
MELTER VIEWING SYSTEM	
PROJECT NO.	542-6120A
DATE	10/1/72
BY	WVW
CHECKED BY	WVW
APPROVED BY	WVW

REVISIONS	DATE	BY	CHKD BY
1	10/1/72	WVW	WVW
2	10/1/72	WVW	WVW
3	10/1/72	WVW	WVW
4	10/1/72	WVW	WVW
5	10/1/72	WVW	WVW
6	10/1/72	WVW	WVW
7	10/1/72	WVW	WVW
8	10/1/72	WVW	WVW
9	10/1/72	WVW	WVW
10	10/1/72	WVW	WVW

APPENDIX D

CONCEPTUAL DESIGN FOR THE HWVP CAMERA

REVISIONS			
NO.	REV.	DESCRIPTION	DATE
1	1	FABRICATION SPECIFICATION CHANGE - 8 WHEN ADDED PN-43	11-2-71

① ASSEMBLY

QTY	SYM	ITEM NO.	DESCRIPTION OR IDENTIFICATION	CODE	PART OR EXISTING NO.	MATERIAL	SPECIFICATION	DATE
PARTS LIST								
DRAWING CODE NUMBER			CONTRACT NO.			A/E CONTRACT NO.		
TOLERANCES - NOT TO SCALE			WEST VALLEY NUCLEAR SERVICES CO., INC.			WEST VALLEY, NEW YORK		
SPEC CODE			MELTER VIEWING SYSTEM ASSEMBLY			SCALE 1/2" = 1"		
			DRAWING NO. PNL-261-02			SHEET 2 OF 12

DETAIL I
MATERIAL: ASTM A 276
304 L SST ROUND

③ MIRROR HOUSING

DETAIL II
MATH, 300 SERIES SST

PARTS LIST & GENERAL NOTES LOCATED ON PNL-26-01, SM 1

SYN NO	ITEM NO	HOLDING DATE OR EXTENSION		CODE EXT NO	DATE OF EXTENT NO	MATERIAL	SPECIFICATION	FOR
PART 1115								
ITEM & ITEM NUMBER		UNLESS OTHERWISE SPECIFIED		CONTRACT NO.		A/C CONTRACT NO.		DATE REVISED
AREA	DATE	EL	ENCL.	FOR				
CHANGES - NOT TO SCALE				West Valley Hammer Services Co., Inc.				
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DETAIL V

④ END CLOSURE

NOTE: RE-BONE .290 DIA HOLE
(SEE DETAIL III) AFTER
WELDING DETAIL I

DETAIL IV

MATL: 2 1/2 SCHED 40, ASTM
Q345 NICKEL ALLOY PIPE

DETAIL III

MATL; ASTM A240 304L
SST PLATE

3 IN	ITEM NO	HOW AND WHEN BY	COST NO	DATE BY	SP. TEMPL	SPEC. E-10N	2 IN
BY REC		NO. BY REC		DATE BY REC			
PART LIST							
SHEET CODE NUMBER		UNITS BY WHICH QUANTITY SPECIFIED		CONTRACT NO.	A-E DRAWING NO.	SHEET NO.	
AREA	PLATE	CL	QTY	DESCRIPTION	SCALE	SHEET NO.	
TOLERANCES - NOT TO SCALE				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
2 PL. REC. 3 PL. REC.				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
.01 .005				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
FUNCTION				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
BYPASS CODE				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
MELTER VIEWING SYSTEM				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
DETAILS				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
SCALE 1/8" = 1'-0"				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
D				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
A-E Dwg. No. PNL-261-05				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		
Sheet 5 of 10				1/8" = 1'-0"	Weld Valley Machine Service Co. Inc.		

Technical drawing of a 12-inch diameter pipe with a 12-inch diameter flange. The drawing includes a side view and a top view. The side view shows a flange with a 12-inch diameter, a 12-inch diameter pipe, and a 12-inch diameter flange. The top view shows a circular flange with a 12-inch diameter, a 12-inch diameter pipe, and a 12-inch diameter flange. The drawing is labeled with dimensions and part numbers.

(12) TOP LENS HOUSING

MATE - ASTM A209 Pipe 13
ALUMINUM TUBE
FINISH - BLACK ANODIZED SEE NOTE D

⑬ JAM SCREW

DATE: APRIL 16 1945 BOUND

⑭ APERTURE DISC

NAME: 4374-0209 2DP6-T2
ALUMINUM 3-667
FINISH: 01 466 ANODIZED-362 mdf 8

15 17 TOP LENSES

NOTES: 1. DM-7G, 18FZG-12
MFD BY SCHOTT GALL
TECHNOLOGIES, INC.
2. NO OPTICAL ADHESIVES TO
BE USED
3. FOR SPECIFICATION SEE
GENERAL NOTE 10

19 JAM NUT

DATE: 4/27/44 4:40 PM 257
PAGE

(18) MIRROR RETAINER

NOTE - SPRING STEEL SMALL BE
HARDENED TO H_C 48 7051,
TEMPERED, POLISHED &
BLUED A13: C1085
(A6TM A29 {1095})

SPACER

MATL - ASTM-A240-304L SS
SHEET

REVISIONS			
ZONE	REV	DESCRIPTION	DATE
		IN ZNG 3 DIM 6.00 WAS 2.03, IN ZNG 5 DIM 3.20 WAS 2.87, IN ZNG 5 DIM 3.20 WAS 2.80 IN ZNG 6 DIM 10.21 WAS 10.35, IN ZNG 11 DIM 3 1/2 WAS 3 3/4, IN ZNG 11.05 DIM WAS 1.05, ALL PERCENT. 261-C-REV 1	1/17/68 JES

[illegible]

21 UPPER MIRROR CAP
MATERIAL: ASTM A240 304L SSF
SCALE: FULL

(20) UPPER MIRROR HOUSING
MATL: A6TH A240 B04L BBT
SCALE: FULL

VIEWING TUBE
MAYL: 1 1/2 OD x .125 W
ASTM-A269 TP
304L SST TUBE
SCALE FULL

(23) FLANGE
MATL: 17.00 OD = 5.08 ID
x 1.00 THK. ASTM-A240
304 L SS

PARTS LIST & GENERAL NOTES
LOCATED ON PNL-26101, 5M1

[illegible]

DETAIL XI

27 LENS GASKET
MATERIAL: 2 LAYERS OF DIB-KOH
THIN, STYLE 3636, GRAFON, SHEET, MFG BY NIPCO CORP OR EQUAL

25 HOLD-DOWN
MATERIAL: ASTM B163 INCONEL 690

26 MIRROR HSG GASKET
MATERIAL: 4 LAYERS OF DIB-KOH THIN, STYLE 3636, GRAFON, SHEET, MFG BY NIPCO CORP OR EQUAL

24 LENS COVER
MATERIAL: ASTM B163 INCONEL 690

28 JACKET
MATERIAL: ASTM B163 INCONEL 690

PARTS LIST & GENERAL NOTES LOCATED ON PUL. TEL-GU, PUL. H

ITEM NO.	DESCRIPTION	QTY	UNIT	REMARKS	DATE	BY	CHKD	APPROVED	REVISION
1	LENS GASKET	1	PC						
2	HOLD-DOWN	1	PC						
3	MIRROR HSG GASKET	1	PC						
4	LENS COVER	1	PC						
5	JACKET	1	PC						

ITEM NO.	DESCRIPTION	QTY	UNIT	REMARKS	DATE	BY	CHKD	APPROVED	REVISION
1	LENS GASKET	1	PC						
2	HOLD-DOWN	1	PC						
3	MIRROR HSG GASKET	1	PC						
4	LENS COVER	1	PC						
5	JACKET	1	PC						

ITEM NO.	DESCRIPTION	QTY	UNIT	REMARKS	DATE	BY	CHKD	APPROVED	REVISION
1	LENS GASKET	1	PC						
2	HOLD-DOWN	1	PC						
3	MIRROR HSG GASKET	1	PC						
4	LENS COVER	1	PC						
5	JACKET	1	PC						

A/E BUG NO. PNL-261-10 SHEET 10 OF 10

1 DIMENSIONING AND TOLERANCING ARE IN ACCORDANCE WITH ANSI Y14.6-79.

- B. CERTIFICATE OF COMPLIANCE REQUIRED ON ALL ENGINEERED PRODUCTS.

1	39	CYC BOLT	AN 3014T43		MASTER-CARB
2	38	SPACER	PNL-262-08		
1	37	SPACER	PNL-262-08		
1	36	FILTER HOUSING			M3A 28006 TYPE A
4	35	BOLT 1/2" DIA X 3" LONG HEX HEAD			ASTM A 193 88 304
12	34	BOLT 1/2" DIA X 3" LONG HEX HEAD			ASTM A 193 88 304
1	33	CARTRIDGE			M3A NO 464033
1	32	FILTER			"ELEMENTS AND SPACERS"
4	31	FILTER RETAINER	PNL-262-08		
1	30	GASKET	PNL-262-08		
1	29	COVER	PNL-262-08		
1	28	BOLT 1/2" DIA X 3" LONG HEX HD			ASTM A 193 88 304
2	27	ELEMENT #2	PNL-262-08		
2	26	GASKET	PNL-262-08		
6	25	BOLT 1/2" DIA X 3" LONG HEX HD			ASTM A 193 88 304
2	24	BOLT 1/2" DIA X 3" LONG HEX HD			ASTM A 193 88 304
1	23	CAMERA SHUTTER	PNL-262-08		
1	22	CAMERA	SEE NOTE 6		ORION - M71 INC
1	21	UPPER MIRROR	PNL-262-08		
1	20	LOWER MIRROR 6" DIA X 1" THK			24-285 OPTICAL CORP
1	19	WAVE SPRING	SSR-0487		SMALLEY STEEL RING CO
1	18	UPPER MIRROR CASE	PNL-262-08		
2	17	BOLT 1/2" DIA X 3" LONG			ASTM A 193 88 304
AR	16	SHIM PEBBLE STONE .002" THK			COMMERCIAL RT
12	15	FLAT HEAD SCREW FLOTTED 6" DIA X 3" LONG			ASTM A 193 88 304
2	14	MIRROR RETAINER	PNL-262-08		
1	13	WAVE SPRING	SSR-0375		SMALLEY STEEL RING CO
1	12	LOWER MIRROR CASE	PNL-262-08		
1	11	BOLT 1/2" DIA X 3" LONG HEX HD			ASTM A 193 88 304
2	10	RETAINER	PNL-262-08		
4	9	WAVE SPRING	PNL-262-08		
1	8	ELEMENT #1	PNL-262-08		
1	7	GLASS SHIELD	SEE NOTE 9		
1	6	CAMERA INSERT	PNL-262-08		
1	5	UPPER MIRROR MIRROR	PNL-262-08		
1	4	LOWER MIRROR INSERT	PNL-262-08		
1	3	LENS HOLDER	PNL-262-08		
1	2	INSERT	PNL-262-08		
1	1	ASSEMBLY	PNL-262-08		

VIEW
1/16"

NEW
HOLDING IN PLACE OR
RE-SCREWED

CODE
P/NL-262-08

PART NO
MASTER-CARB

UNITS
M3A 28006 TYPE A

SPECIFIC
ASTM A 193 88 304

PAGE 1700 NUMBER				PAGE NUMBER RECEIVED				CONTACT NO.				A/E CONTACT NO.				C/SR SENT NO.			
WKS	SEC	FILE	IN	OPEN	INTERFERENCE NOT TO SCALE				1/2" = 1' SCALE 1/4" = 1' SCALE 1/8" = 1' SCALE 1/16" = 1' SCALE 1/32" = 1' SCALE 1/64" = 1' SCALE 1/128" = 1' SCALE 1/256" = 1' SCALE 1/512" = 1' SCALE 1/1024" = 1' SCALE 1/2048" = 1' SCALE 1/4096" = 1' SCALE 1/8192" = 1' SCALE 1/16384" = 1' SCALE 1/32768" = 1' SCALE 1/65536" = 1' SCALE 1/131072" = 1' SCALE 1/262144" = 1' SCALE 1/524288" = 1' SCALE 1/1048576" = 1' SCALE 1/2097152" = 1' SCALE 1/4194304" = 1' SCALE 1/8388608" = 1' SCALE 1/16777216" = 1' SCALE 1/33554432" = 1' SCALE 1/67108864" = 1' SCALE 1/134217728" = 1' SCALE 1/268435456" = 1' SCALE 1/536870912" = 1' SCALE 1/1073741824" = 1' SCALE 1/2147483648" = 1' SCALE 1/4294967296" = 1' SCALE 1/8589934592" = 1' SCALE 1/17179869184" = 1' SCALE 1/34359738368" = 1' SCALE 1/68719476736" = 1' SCALE 1/137438953472" = 1' SCALE 1/274877906944" = 1' SCALE 1/549755813888" = 1' SCALE 1/1099511627776" = 1' SCALE 1/2199023255552" = 1' SCALE 1/4398046511104" = 1' SCALE 1/8796093022208" = 1' 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① ASSEMBLY

STW NO	ITEM NO	NAME & PHONE OR COMPANY			CODE NO	PRINT NO OR PRINTING NO	ATTENDING	SPECIAL INSTRUCTIONS	FILE
PARTS LIST									
REEL CODE NUMBER		UNLESS OTHERWISE SPECIFIED			CONTRACT NO		DATE ORDERED		
AME	DATE	QTY	CD	CONC.	1/2 IN. 1/4 IN. 3/8 IN. 1/2 IN. 3/4 IN. 1 IN. 1 1/4 IN. 1 1/2 IN. 2 IN. 2 1/2 IN. 3 IN. 4 IN. 6 IN. 8 IN. 10 IN. 12 IN. 14 IN. 16 IN. 18 IN. 20 IN. 24 IN. 30 IN. 36 IN. 42 IN. 48 IN. 54 IN. 60 IN. 72 IN. 84 IN. 96 IN. 108 IN. 120 IN. 144 IN. 168 IN. 192 IN. 216 IN. 240 IN. 270 IN. 300 IN. 324 IN. 360 IN. 400 IN. 450 IN. 500 IN. 540 IN. 600 IN. 648 IN. 720 IN. 800 IN. 864 IN. 960 IN. 1080 IN. 1200 IN. 1344 IN. 1440 IN. 1600 IN. 1728 IN. 1920 IN. 2160 IN. 2400 IN. 2700 IN. 3000 IN. 3240 IN. 3600 IN. 4000 IN. 4500 IN. 5000 IN. 5400 IN. 6000 IN. 6480 IN. 7200 IN. 8000 IN. 8640 IN. 9600 IN. 10800 IN. 12000 IN. 13440 IN. 14400 IN. 16000 IN. 17280 IN. 19200 IN. 21600 IN. 24000 IN. 27000 IN. 30000 IN. 32400 IN. 36000 IN. 40000 IN. 45000 IN. 50000 IN. 54000 IN. 60000 IN. 64800 IN. 72000 IN. 80000 IN. 86400 IN. 96000 IN. 108000 IN. 120000 IN. 134400 IN. 144000 IN. 160000 IN. 172800 IN. 192000 IN. 216000 IN. 240000 IN. 270000 IN. 300000 IN. 324000 IN. 360000 IN. 400000 IN. 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REVISIONS		DESCRIPTION	DATE	APPROVED
1	12.12.04	12.12.04	12.12.04	12.12.04

④ LOWER MIRROR INSERT
ASTM A 240 304L

REV	REV	DESCRIPTION	DATE	BY	CHKD
1	1	12.12.04	12.12.04	12.12.04	12.12.04

PROJECT NO.	12.12.04	DATE OF REV.	12.12.04
DESIGNED BY	12.12.04	DESIGNED BY	12.12.04
CHECKED BY	12.12.04	CHECKED BY	12.12.04
APPROVED BY	12.12.04	APPROVED BY	12.12.04

SCALE	1/2\"/>
 

29 COVER PLATE
MATERIAL ASTM A240 304
"B" GAGE

DETAIL V
MATERIAL APPROX 3044 "H 6468

23 CAMERA SUPPORT
MATERIAL ASTM A36 304L

VIEW CC

⑥ CAMERA INSERT
MATERIAL ASTM A340 304L

31 FILTER RETAINER
MATERIAL ASTM A240 304L

DETAIL VIII

DATE 01/14/84	VIEW NO	HOW HAS A VIEW BE SCANNED	CLOCK SERIAL NO	PART NO SERIAL NO	UNIT NO	PNL NO. - 1000	IS
PART 1.67							
BASE CAGE NUMBER			UNLESS OTHERWISE SPECIFIED		CONTRACT NO.		CAGE IDENT NO.
ANG.	FEET	IN.	CMG.	TOLERANCES - NOT TO SCALE		West Valley Nuclear Services Co. Inc. MELTER VIEWING SYSTEM WALL PLUG DETAILS	
SPEC CODE				2 P. REC 3 P. REC 4 G. REC 1. 61 2. 0.05 3. 0.25 4. 0.50 5. 0.75 6. 1.00 7. 1.25 8. 1.50 9. 1.75 10. 2.00 11. 2.25 12. 2.50 13. 2.75 14. 3.00 15. 3.25 16. 3.50 17. 3.75 18. 4.00 19. 4.25 20. 4.50 21. 4.75 22. 5.00 23. 5.25 24. 5.50 25. 5.75 26. 6.00 27. 6.25 28. 6.50 29. 6.75 30. 7.00 31. 7.25 32. 7.50 33. 7.75 34. 8.00 35. 8.25 36. 8.50 37. 8.75 38. 9.00 39. 9.25 40. 9.50 41. 9.75 42. 10.00 43. 10.25 44. 10.50 45. 10.75 46. 11.00 47. 11.25 48. 11.50 49. 11.75 50. 12.00 51. 12.25 52. 12.50 53. 12.75 54. 13.00 55. 13.25 56. 13.50 57. 13.75 58. 14.00 59. 14.25 60. 14.50 61. 14.75 62. 15.00 63. 15.25 64. 15.50 65. 15.75 66. 16.00 67. 16.25 68. 16.50 69. 16.75 70. 17.00 71. 17.25 72. 17.50 73. 17.75 74. 18.00 75. 18.25 76. 18.50 77. 18.75 78. 19.00 79. 19.25 80. 19.50 81. 19.75 82. 20.00 83. 20.25 84. 20.50 85. 20.75 86. 21.00 87. 21.25 88. 21.50 89. 21.75 90. 22.00 91. 22.25 92. 22.50 93. 22.75 94. 23.00 95. 23.25 96. 23.50 97. 23.75 98. 24.00 99. 24.25 100. 24.50 101. 24.75 102. 25.00 103. 25.25 104. 25.50 105. 25.75 106. 26.00 107. 26.25 108. 26.50 109. 26.75 110. 27.00 111. 27.25 112. 27.50 113. 27.75 114. 28.00 115. 28.25 116. 28.50 117. 28.75 118. 29.00 119. 29.25 120. 29.50 121. 29.75 122. 30.00 123. 30.25 124. 30.50 125. 30.75 126. 31.00 127. 31.25 128. 31.50 129. 31.75 130. 32.00 131. 32.25 132. 32.50 133. 32.75 134. 33.00 135. 33.25 136. 33.50 137. 33.75 138. 34.00 139. 34.25 140. 34.50 141. 34.75 142. 35.00 143. 35.25 144. 35.50 145. 35.75 146. 36.00 147. 36.25 148. 36.50 149. 36.75 150. 37.00 151. 37.25 152. 37.50 153. 37.75 154. 38.00 155. 38.25 156. 38.50 157. 38.75 158. 39.00 159. 39.25 160. 39.50 161. 39.75 162. 40.00 163. 40.25 164. 40.50 165. 40.75 166. 41.00 167. 41.25 168. 41.50 169. 41.75 170. 42.00 171. 42.25 172. 42.50 173. 42.75 174. 43.00 175. 43.25 176. 43.50 177. 43.75 178. 44.00 179. 44.25 180. 44.50 181. 44.75 182. 45.00 183. 45.25 184. 45.50 185. 45.75 186. 46.00 187. 46.25 188. 46.50 189. 46.75 190. 47.00 191. 47.25 192. 47.50 193. 47.75 194. 48.00 195. 48.25 196. 48.50 197. 48.75 198. 49.00 199. 49.25 200. 49.50 201. 49.75 202. 50.00 203. 50.25 204. 50.50 205. 50.75 206. 51.00 207. 51.25 208. 51.50 209. 51.75 210. 52.00 211. 52.25 212. 52.50 213. 52.75 214. 53.00 215. 53.25 216. 53.50 217. 53.75 218. 54.00 219. 54.25 220. 54.50 221. 54.75 222. 55.00 223. 55.25 224. 55.50 225. 55.75 226. 56.00 227. 56.25 228. 56.50 229. 56.75 230. 57.00 231. 57.25 232. 57.50 233. 57.75 234. 58.00 235. 58.25 236. 58.50 237. 58.75 238. 59.00 239. 59.25 240. 59.50 241. 59.75 242. 60.00 243. 60.25 244. 60.50 245. 60.75 246. 61.00 247. 61.25 248. 61.50 249. 61.75 250. 62.00 251. 62.25 252. 62.50 253. 62.75 254. 63.00 255. 63.25 256. 63.50 257. 63.75 258. 64.00 259. 64.25 260. 64.50 261. 64.75 262. 65.00 263. 65.25 264. 65.50 265. 65.75 266. 66.00 267. 66.25 268. 66.50 269. 66.75 270. 67.00 271. 67.25 272. 67.50 273. 67.75 274. 68.00 275. 68.25 276. 68.50 277. 68.75 278. 69.00 279. 69.25 280. 69.50 281. 69.75 282. 70.00 283. 70.25 284. 70.50 285. 70.75 286. 71.00 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115.25 464. 115.50 465. 115.75 466. 116.00 467. 116.25 468. 116.50 469. 116.75 470. 117.00 471. 117.25 472. 117.50 473. 117.75 474. 118.00 475. 118.25 476. 118.50 477. 118.75 478. 119.00 479. 119.25 480. 119.50 481. 119.75 482. 120.00 483. 120.25 484. 120.50 485. 120.75 486. 121.00 487. 121.25 488. 121.50 489. 121.75 490. 122.00 491. 122.25 492. 122.50 493. 122.75 494. 123.00 495. 123.25 496. 123.50 497. 123.75 498. 124.00 499. 124.25 500. 124.50 501. 124.75 502. 125.00 503. 125.25 504. 125.50 505. 125.75 506. 126.00 507. 126.25 508. 126.50 509. 126.75 510. 127.00 511. 127.25 512. 127.50 513. 127.75 514. 128.00 515. 128.25 516. 128.50 517. 128.75 518. 129.00 519. 129.25 520. 129.50 521. 129.75 522. 130.00 523. 130.25 524. 130.50 525. 130.75 526. 131.00 527. 131.25 528. 131.50 529. 131.75 530. 132.00 531. 132.25 532. 132.50 533. 132.75 534. 133.00 535. 133.25 536. 133.50 537. 133.75 538. 134.00 539. 134.25 540. 134.50 541. 134.75 542. 135.00 543. 135.25 544. 135.50 545. 135.75 546. 136.00 547. 136.25 548. 136.50 549. 136.75 550. 137.00 551. 137.25 552. 137.50 553. 137.75 554. 138.00 555. 138.25 556. 138.50 557. 138.75 558. 139.00 559. 139.25 560. 139.50 561. 139.75 562. 140.00 563. 140.25 564. 140.50 565. 140.75 566. 141.00 567. 141.25 568. 141.50 569. 141.75 570. 142.00 571. 142.25 572. 142.50 573. 142.75 574. 143.00 575. 143.25 576. 143.50 577. 143.75 578. 144.00 579. 144.25 580. 144.50 581. 144.75 582. 145.00 583. 145.25 584. 145.50 585. 145.75 586. 146.00 587. 146.25 588. 146.50 589. 146.75 590. 147.00 591. 147.25 592. 147.50 593. 147.75 594. 148.00 595. 148.25 596. 148.50 597. 148.75 598. 149.00 599. 149.25 600. 149.50 601. 149.75 602. 150.00 603. 150.25 604. 150.50 605. 150.75 606. 151.00 607. 151.25 608. 151.50 609. 151.75 610. 152.00 611. 152.25 612. 152.50 613. 152.75 614. 153.00 615. 153.25 616. 153.50 617. 153.75 618. 154.00 619. 154.25 620. 154.50 621. 154.75 622. 155.00 623. 155.25 624. 155.50 625. 155.75 626. 156.00 627. 156.25 628. 156.50 629. 156.75 630. 157.00 631. 157.25 632. 157.50 633. 157.75 634. 158.00 635. 158.25 636. 158.50 637. 158.75 638. 159.00 639. 159.25 640. 159.50 641. 159.75 642. 160.00 643. 160.25 644. 160.50 645. 160.75 646. 161.00 647. 161.25 648. 161.50 649. 161.75 650. 162.00 651. 162.25 652. 162.50 653. 162.75 654. 163.00 655. 163.25 656. 163.50 657. 163.75 658. 164.00 659. 164.25 660. 164.50 661. 164.75 662. 165.00 663. 165.25 664. 165.50 665. 165.75 666. 166.00 667. 166.25 668. 166.50 669. 166.75 670. 167.00 671. 167.25 672. 167.50 673. 167.75 674. 168.00 675. 168.25 676. 168.50 677. 168.75 678. 169.00 679. 169.25 680. 169.50 681. 169.75 682. 170.00 683. 170.25 684. 170.50 685. 170.75 686. 171.00 687. 171.25 688. 171.50 689. 171.75 690. 172.00 691. 172.25 692. 172.50 693. 172.75 694. 173.00 695. 173.25 696. 173.50 697. 173.75 698. 174.00 699. 174.25 700. 174.50 701. 174.75 702. 175.00 703. 175.25 704. 175.50 705. 175.75 706. 176.00 707. 176.25 708. 176.50 709. 176.75 710. 177.00 711. 177.25 712. 177.50 713. 177.75 714. 178.00 715. 178.25 716. 178.50 717. 178.75 718. 179.00 719. 179.25 720. 179.50 721. 179.75 722. 180.00 723. 180.25 724. 180.50 725. 180.75 726. 181.00 727. 181.25 728. 181.50 729. 181.75 730. 182.00 731. 182.25 732. 182.50 733. 182.75 734. 183.00 735. 183.25 736. 183.50 737. 183.75 738. 184.00 739. 184.25 740. 184.50 741. 184.75 742. 185.00 743. 185.25 744. 185.50 745. 185.75 746. 186.00 747. 186.25 748. 186.50 749. 186.75 750. 187.00 751. 187.25 752. 187.50 753. 187.75 754. 188.00 755. 188.25 756. 188.50 757. 188.75 758. 189.00 759. 189.25 760. 189.50 761. 189.75 762. 190.00 763. 190.25 764. 190.50 765. 190.75 766. 191.00 767. 191.25 768. 191.50 769. 191.75 770. 192.00 771. 192.25 772. 192.50 773. 192.75 774. 193.00 775. 193.25 776. 193.50 777. 193.75 778. 194.00 779. 194.25 780. 194.50 781. 194.75 782. 195.00 783. 195.25 784. 195.50 785. 195.75 786. 196.00 787. 196.25 788. 196.50 789. 196.75 790. 197.00 791. 197.25 792. 197.50 793. 197.75 794. 198.00 795. 198.25 796. 198.50 797. 198.75 798. 199.00 799. 199.25 800. 199.50 801. 199.75 802. 200.00 803. 200.25 804. 200.50 805. 200.75 806. 201.00 807. 201.25 808. 201.50 809. 201.75 810. 202.00 811. 202.25 812. 202.50 813. 202.75 814. 203.00 815. 203.25 816. 203.50 817. 203.75 818. 204.00 819. 204.25 820. 204.50 821. 204.75 822. 205.00 823. 205.25 824. 205.50 825. 205.75 826. 206.00 827. 206.25 828. 206.50 829. 206.75 830. 207.00 831. 207.25 832. 207.50 833. 207.75 834. 208.00 835. 208.25 836. 208.50 837. 208.75 838. 209.00 839. 209.25 840. 209.50 841. 209.75 842. 210.00 843. 210.25 844. 210.50 845. 210.75 846. 211.00 847. 211.25 848. 211.50 849. 211.75 850. 212.00 851. 212.25 852. 212.50 853. 212.75 854. 213.00 855. 213.25 856. 213.50 857. 213.75 858. 214.00 859. 214.25 860. 214.50 861. 214.75 862. 215.00 863. 215.25 864. 215.50 865. 215.75 866. 216.00 867. 216.25 868. 216.50 869. 216.75 870. 217.00 871. 217.25 872. 217.50 873. 217.75 874. 218.00 875. 218.25 876. 218.50 877. 218.75 878. 219.00 879. 219.25 880. 219.50 881. 219.75 882. 220.00 883. 220.25 884. 220.50 885. 220.75 886. 221.00 887. 221.25 888. 221.50 889. 221.75 890. 222.00 891. 222.25 892. 222.50 893. 222.75 894. 223.00 895. 223.25 896. 223.50 897. 223.75 898. 224.00 899. 224.25 900. 224.50 901. 224.75 902. 225.00 903. 225.25 904. 225.50 905. 225.75 906. 226.00 907. 226.25 908. 226.50 909. 226.75 910. 227.00 911. 227.25 912. 227.50 913. 227.75 914. 228.00 915. 228.25 916. 228.50 917. 228.75 918. 229.00 919. 229.25 920. 229.50 921. 229.75 922. 230.00 923. 230.25 924. 230.50 925. 230.75 926. 231.00 927. 231.25 928. 231.50 929. 231.75 930. 232.00 931. 232.25 932. 232.50 933. 232.75 934. 233.00 935. 233.25 936. 233.50 937. 233.75 938. 234.00 939. 234.25 940. 234.50 941. 234.75 942. 235.00 943. 235.25 944. 235.50 945. 235.75 946. 236.00 947. 236.25 948. 236.50 949. 236.75 950. 237.00 951. 237.25 952. 237.50 953. 237.75 954. 238.00 955. 238.25 956. 238.50 957. 238.75 958. 239.00 959. 239.25 960. 239.50 961. 239.75 962. 240.00 963. 240.25 964. 240.50 965. 240.75 966. 241.00 967. 241.25 968. 241.50 969. 241.75 970. 242.00 971. 242.25 972. 242.50 973. 242.75 974. 243.00 975. 243.25 976. 243.50 977. 243.75 978. 244.00 979. 244.25 980. 244.50 981. 244.75 982. 245.00 983. 245.25 984. 245.50 985. 245.75 986. 246.00 987. 246.25 988. 246.50 989. 246.75 990. 247.00 991. 247.25 992. 247.50 993. 247.75 994. 248.00 995. 248.25 996. 248.50 997. 248.75 998. 249.00 999. 249.25 1000. 249.50 1001. 249.75 1002. 250.00 1003. 250.25 1004. 250.50 1005. 250.75 1006. 251.00 1007. 251.25 1008. 251.50 1009. 251.75 1010. 252.00 1011. 252.25 1012. 252.50 1013. 252.75 1014. 253.00 1015. 253.25 1016. 253.50 1017. 253.75 1018. 254.00 1019. 254.25 1020. 254.50 1021. 254

RETAINER
PLATE 417M 4140 9041

12 LOWER MIRROR CASE
NATL. ASTM A 240 18-8

18 UPPER MIRROR CASE
MATL ASTM A510 304 L

5 UPPER MIRROR HOLDER
MATERIAL: ASTM A160 JOAL

[illegible]

APPENDIX E

NEW PNL CAMERA DESIGN

QTY/PN	DESCRIPTION	MATL / REF
1 30	VIDEO CAMERA SEE NOTE 10	PAGE-MTI, INC.
10 31	SCR SCH CAP "0.1MHC-2A 1/2 L	33T
4 32	LOCK WASHER 3/16 DIA X 1/2 THK	33T
1 33	MIRROR 3/16 DIA X 1/2 THK	LEADER OPTICS CO
1 34	VISIBLE TRANSMITTING FILTER 50% 2MM 30 X 3 X 2MM THK ON FUSED QUARTZ SUBSTRATE	HELIX OPT, NEVINE, CA PN 03AHNG-007
1 35	INFRARED TRANSMITTING FILTER 50% 2MM 50 X 3 X 2MM THK ON FUSED QUARTZ SUBSTRATE	HELIX OPT, NEVINE, CA PN 03AHNG-008
2 36	MALE CONNECTORS "35-200-1-18T	35HUB
1 37	THERMOCOUPLE ASSEMBLY	CONAX, CAT NO. K-3342-U-AJ-40"
2 38	MALE ELBOW, "35-400-2-1	35HUB
1 39	CONNECTOR	TYT CAMION 7202-10-2V-5/8"
2 40	BULKHEAD UNION "35-400-1-1	35HUB
4 41	TUBING 1/4 OD X .035 WALL 316L SS	33T
1 42	STRAIN RELIEF FITTING	O.S. DECHET CO CAT NO. 36308
1 43	PLUG, QUICK DISCONNECT	HANSEN PN 44
4 44	SCR SCH CAP 3/16 DIA X 1/2 L	33T
2 45	SHOULDER SCR 3/16 DIA X 1/2 L	33T
1 46	GASKET	342

GENERAL NOTES (UNLESS OTHERWISE SPECIFIED)

- DIMENSIONS & TOLERANCES ARE IN ACCORDANCE WITH ANSI Y14.5M-1982. ALL DIMENSIONS ARE IN UNLESS TOLERANCES: ANGULAR: $\pm 0.10^\circ$
DECIMALS: $\pm .005$; $\pm .002$; $\pm .010$
- ALL MACHINED SURFACES, SURFACE TEXTURE SHALL BE IN ACCORDANCE WITH ANSI B46.1, EXCEPT GLASS PARTS
- REMOVE ALL BURRS IN BORE AND ALL SHARP EDGES.
- WELDING SYMBOLS ARE IN ACCORDANCE WITH AWS A3.6-78
- ABBREVIATIONS ARE IN ACCORDANCE WITH ANSI Y14.1-1975
- ADJUST TUBE END (PN 15) TO MATCH WITH 1/4" THREADED NIPPLE ON PN 2 (3/4 X 3/4)
- AIR LEAKS TO BE SEALED WITH GENERAL ELECTRIC CO RTV 100; OUT OF MELTER CHAM.
- WELDING SHALL BE PER THE APPLICABLE REQUIREMENTS OF AWS D1.1-88 EXCEPT THAT WELDER QUALIFICATION FOR "316 STAINLESS" SHALL BE DONE IN ACCORDANCE WITH AWS D10.2-77 BE AS PER SECTION IX 1983
- VISUAL (VT) INSPECTION AND ACCEPTANCE CRITERIA SHALL BE IN ACCORDANCE WITH AWS D1.1, PARAGRAPH 8.1.1.
- BLACK AND WHITE HIGH RESOLUTION MODEL HC-67 TELEVISION CAMERA WITH 1/8" VIEWFINDER WITH QUARTZ FACE PLATE 25 FEET CABLE BETWEEN CAMERA HEAD AND REMOTE CONTROL UNIT.
- PROVIDE .50 MM WIDE GASKET BETWEEN PART NO. 2, 3 & 4 (3/4 X 2). MATERIAL SHALL BE GRAPHITE 5088 OR 3636, .015 THK. MFR. 3636 CORP. BIRMINGHAM, AL.
- MOUNT TWO WASHERS (PN 35) IN SERIES AT TWO LOCATIONS BETWEEN PN 41 AND PN 50

QTY/PN	DESCRIPTION	MATL / REF
1 1	ASSEMBLY	
1 2	HOUSING (MOUNTING)	343
1 3	COVER, UPPER	344
1 4	COVER, LOWER	344
1 5	TUBE, CENTER	346
2 6	MIRROR MOUNT	344
1 7	LENS HOUSING	345
1 8	LENS RETAINER, UPPER	345
1 9	LENS RETAINER, LOWER	345
1 10	LENS RETAINER, CENTER	345
1 11	LENS, LONG	345
1 12	LENS, CENTER	345
1 13	LENS, UPPER	345
1 14	TUBE, OUTER	346
1 15	TUBE, INNER	346
1 16	PLATE, RETAINING	347
1 17	SUPPORT, MIRROR	347
1 18	SUPPORT, MIRROR	347
1 19	GASKET	347
1 20	PLATE, FILTER	347
1 21	PLATE, FILTER	347
1 22	LENS HOUSING	348
1 23	LENS RETAINER	348
1 24	SPACER	348
1 25	HEX JAMNUT	348
1 26	LENS TOP	348
1 27	LENS BOTTOM	348
1 28	RETAINER, ADJUSTING	347
1 29	PLATE, ADJUSTING	348
1 30	MOUNT, CAMERA	347
4 31	SCR SCH CAP 3/16 DIA X 1/2 L	33T
4 32	SCR SCH CAP "0.1MHC-2A 1/2 L	33T
4 33	WASHER, BELT/PALF	342 "34635-002-3
4 34	SCR, PN 40 NUT 1/4 DIA X 3/4 L	33T
4 35	LOCK WASHER 1/4 DIA X 3/4 L	33T
1 36	NUT, HEX 1/4 DIA X 3/4 L	33T
1 37	THUMB SCREW TORQUE (1/4 DIA)	44103 "GC-1
4 38	SCR, PN 40 NUT 1/4 DIA X 3/4 L	33T
4 39	NUT, HEX 1/4 DIA X 3/4 L	33T
4 40	WASHER 1/2 DIA X 1/4 THK 316L SS	33T
3 41	SCR, HEX NO CAP 1/2 DIA X 3/4 L	33T
34 42	SCR, HEX NO CAP 3/16 DIA X 1/2 L	33T
34 43	LOCK WASHER 3/16 DIA X 1/2 THK 316L SS	33T
4 44	SCR, SCH CAP "0.1MHC-2A 1/2 L	33T
12 45	SPRING	342 "34635-002-3
4 46	PN 40 NUT 1/4 DIA X 3/4 L	33T
2 47	WASHER 3/16 DIA X 1/4 THK 316L SS	33T
4 48	SHOULDER SCREW 1/4 DIA X 3/4 L	33T
4 49	WASHER 1/4 DIA X 1/4 THK 316L SS	33T

2ND ISSUE 6-5-82

JOP-1442

U.S. Department of Energy Pacific Northwest Laboratory BETHEAVILLE, OREGON 97007	
MELTER VIEWING SYSTEM PARTS LIST AND NOTES	
REV 324 2011	REV 57005A
587-26463 1118	

Technical drawing of a rectangular frame structure. The drawing includes the following dimensions and annotations:

- Top horizontal dimension: 4.75
- Top horizontal dimension (inner): $2 \times 2.063 (= 4.250)$
- Left vertical dimension (top section): 2.5
- Left vertical dimension (middle section): $14 \times 2.000 (= 28.000)$
- Left vertical dimension (bottom section): 28.46
- Right vertical dimension: $34 \times \phi .566$
- Bottom horizontal dimension: 4.75

The drawing shows a rectangular frame with a central vertical section and a horizontal section at the bottom. The dimensions are given in millimeters. The frame is composed of several parts, including a top section, a middle section, and a bottom section. The dimensions are labeled with arrows indicating the measurement direction.

③ COVER, UPPER
MATERIAL: .50 THK. PLATE
300 SERIES SST

④ COVER, LOWER
MATERIAL: .50 THK. PLATE
300 SERIES SST

⑤ TUBE, CENTER
MAYLE 300 SERIES SST

⑥ MIRROR MOUNT
MAIL: 300 SERIES SST

SEE SH 1 FOR PARTS LIST
AND GENERAL NOTES

2ND ISSUE 6-5-76 JOP# 1442

U.S. Department of Energy
Richard Goodwin, Chief

PACIFIC NORTHWEST LABORATORY
OFFICE OF NORTHWEST REGIONAL ACTIVITIES

MELTER VIEWING
SYSTEM
DETAILS

223 (REV.) DATE 12-27-78

SK-3-26468 1-13

SEE SHEET 1 FOR PARTS LIST
AND GENERAL NOTES

201 ISSUE 6-5-86

JUN 1986 1442

U. S. Department Of Energy
Building Research Office
PACIFIC NORTHWEST LABORATORY
operated by Battelle Memorial Institute

MELTER VIEWING
SYSTEM
DETAILS

NOTED

NOT RECD

NOV 1986

5K3-2G468

SPCCB

5118

2X .250-16NPT

.875"

4X Ø.219
L Ø.375 X F.22

3.250

Ø.62-21NPT

1.435

3.096
3.036
-A-

2.00
SEE NOTE 6

115-125ST FERRULE
PARKER HOSE REGD. DIV.

OPTIONAL DESIGN

Ø.750 K.035 WALL
SEAMLESS TUBING

1.50
SEE NOTE 6

.404

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2ND ISSUE 6-6-56

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FILTER FEEDING SYSTEM

SYSTEM DETAILS

DETAILS

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