Closed-Circuit Television and its Application in Municipal Incineration

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Abstract

Closed-circuit television has been applied to a municipal incinerator plant with two 250-ton-a-day furnaces. Two cameras monitor the storage pit and crane operation, while one camera watches the fire in each furnace.

The paper discusses the features of the equipment, the cost and advantages.

Introduction

The use of closed-circuit television in industry, business and education has advanced very rapidly in the last 10 years. Industrial uses alone have stimulated a market topping the $30 million mark in the last decade. Probably the largest single industrial user is to be found in the power generation industry. It is estimated that there are well over 1200 units of closed-circuit television in the utilities field (Power Magazine, July 1964). Using Long Island, N.Y., as a good example, it is reliably reported that every power plant constructed there in the last five years has been equipped with closed-circuit television in order to monitor and supervise, in the most efficient way, all the critical functions of the plants.

Vidicon Cameras Used

Closed-circuit television, called CCTV for short, is a comparatively simple system. It consists of a camera and its associated power unit connected by coaxial cable to a monitor screen. Having no radiated or broadcast signals, CCTV's primary aim of system reliability is easier and less expensive to achieve than home or commercial TV.

There are three types of cameras in use in CCTV. They are the Orthicon, Vidicon and Image Dissector, depending on the type of viewing tube installed. Orthicon is too delicate for industrial use and it is, therefore, generally confined to broadcast studios. Image Dissector is outstanding where extreme ruggedness is a major factor to be considered. It does not, however, provide the definitiveness of image resolution that a Vidicon does. The latter characteristic, plus Vidicon’s lower initial cost, make it most practical for incinerator use. When it is further realized that the Vidicon camera can be given a special housing and air-cooling system, to afford reliability under arduous conditions, then its adaptability to incinerator installation is obvious.

Interestingly enough, it was this firm's investigation at the Long Island Lighting Company which led to the conviction that closed-circuit television would serve essential functions in modern municipal incinerator design – functions of economy, safety and reliability which could be served in no other way.

This conviction is currently being put to the test at a new, highly mechanized municipal incinerator plant located in Oyster Bay, New York. The new plant has a daily refuse disposal capacity of 500 tons. Two adjacent furnaces, each capable of handling 250 tons daily, burn the refuse as it passes over hydraulically operated
constant-flo grates. Closed-circuit television units serve to monitor the operation from the refuse storage bin through the two furnaces.

It is believed that the Oyster Bay plant is this country's first such installation to be monitored and, in effect, supervised through closed-circuit television. The television units, all standard parts, were purchased and installed at a cost of $25,000. It is estimated that the system can save the municipality two and possibly three times that amount annually in labor costs alone.

It was not initially the question of costs which led to an investigation of CCTV; it was a concern for human safety.

Having designed and visited a number of municipal incinerators in the New York metropolitan area, this firm was aware of the concern of the Plant Management, the Town Board and the Civil Service Employees Association regarding the safety of the plant personnel whose job it was to periodically stoke or inspect, by means of doors opening directly into the furnace, the condition of burning refuse en route over the grates. Such workers had always been in danger from exploding matter, such as aerosol cans, within the furnace.

The question was raised as to the possibility of having the inspection done by means of television cameras. Once raised, the question spontaneously led to a realization of the further benefits from such a system — economy and continuous reliability. However, the intense heat generated within an incinerator furnace and the dust conditions within the charging floor and refuse bin areas seemed, for a while, to militate against such a proposal. It was only after research done at the Long Island Lighting Company’s plant at Inwood, where CCTV was in service in conditions of intense heat and other factors of plant environment, that it was agreed that television could be utilized.

**Plant Comparison**

Actually, there are two incinerator plants at Oyster Bay, each with a 500-ton capacity. One, however, is an older plant where the furnace stokers are manually operated. In this plant there are four furnaces, each with a capacity of 125 tons. Sixty men are employed in this plant. Henry J. Campbell Jr. and Associates introduced certain improvements into the older plant before designing the new plant served by CCTV. The new project totaled $2.5 million. The point here is that there will now be no need to employ any additional personnel to run the new plant. CCTV, essentially, has been instrumental in effecting this important economy.

**How CCTV System Works**

Installing closed-circuit television in the new plant proved not at all to be a complicated task. Stock equip-

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**Camera Location**

Key to any system will be the location of the cameras and their cone of vision, as well as the measures taken to prevent damage to the CCTV equipment from the intense ambient heat. Measures must also be taken to keep the critical elements of the system as dust-free as possible.

Regarding camera locations and their cone of vision, criteria for such were furnished to the manufacturer who, in turn, supplied this firm with suggested drawings and specifications containing their recommendations. Our demands included a complete view-span of the refuse storage bin and a view of the latter portions, including side walls and grates, of the two furnace interiors. A view of the grates and walls from the stoker discharge end is best, because experience has shown that most difficulties within a furnace can be seen from that direction. However, only actual operation will prove out this camera location; and if additional cameras are required; an expanded system with slight modification can be accomplished.

Two cameras are placed at the charging floor level, each covering respective halves of the storage bin, from its bottom to a height of approximately 40 feet. This bin is 120 feet in length and 30 feet wide and reaches a height of 30 feet at the tipping platform. The rear wall of the bin is approximately 50 feet in height. It is obvious that the two cameras located at the charging floor level cannot possibly span the entire area — just as the furnace cameras cover only a portion (to be sure, the most critical portion) of the furnace interior. Although full and comprehensive camera coverage is theoretically possible, it is not considered necessary because sufficient information can be obtained from a consistent reading of critically representative areas of the plant operation.

Cameras viewing the furnaces “look” through an aperture in the rear walls. They afford a view of the final grate section, a portion of the preceding grate section and a large expanse of the walls on either side.

The furnaces are 50 feet long and 8 feet wide. The
Grates in the two furnaces are divided into four equal sections. The furnace grates supply a "floor" to the burning refuse that inclines downward at an angle of 11½ degrees. This floor of four separate sections agitates the refuse downward. The cameras—one for each furnace—afford a view of about 140 square feet of the grates and about 200 square feet on each of the side walls in the two furnaces.

The furnace cameras are protected from the intense heat by their own independent compressed-air cooling system. They would have to be cooled because their temperature tolerance extends to only 131 °F. Furnace temperatures may be as high as 1800 °F, and the actual flame temperature may reach 3000 °F.

Cool and filtered air is circulated inside the camera housing and through the internal shell of the lens tube. The lens tube, which is 18 inches long, is secured to the exterior furnace wall and affords a view into the furnace.
This is accomplished by means of an aperture that measures approximately 3 inches on the outside wall and expands to 4 inches in width by 12 inches in depth on the interior refractory wall.

The cool air, which is forced around the equipment at a pressure of 10 pounds per square inch, also provides a cooling air “wall” in front of the objective lens which faces on the interior of the furnace. This wall results from the compressed air being exhausted into the furnace at 50 cubic feet per minute. In addition to maintaining a safe operating temperature, the rapid air flow inhibits the accumulation of foreign particles on the lens surface. It is not likely that the temperature at this point would ever exceed 120°F, well within the 131°F tolerance.

If an air failure ever occurs, an alarm system will flash the words “No Air” on the control monitoring screen and station air will cool the cameras until the outage is corrected. The equipment can be removed from the furnace wall within a matter of seconds by sliding out the cameras along a retractable carriage.

The furnace cameras are housed in nickel-chrome plated sheathing to further resist heat and ambient conditions. Both the furnace and bin cameras are also constructed to be dust proof. Dust, can become a problem for the camera lenses in the storage bin area. The best preventive here is through the timely use of water sprays and exhaust fans over the bin to keep dust to a minimum.

The monitoring control station, where the plant supervisor is located, is situated in an office between the two furnaces. His monitoring console has two screens. He has the following options for viewing: the two furnaces, each on one screen; one or the other of the furnaces and one or the other half of the bin, each on a separate screen; and each of the two sections of the bin, each section on one screen.

The supervisor also has controls at his fingertips affecting all critical operations of the plant, such as overfire and underfire air and water spray control, as well as indicators showing the effect of draft, temperature and air pollution control. He has a P.A. system available which reaches throughout the plant, and he can be in direct voice communication with the crane operator over the refuse storage bin.

**Advantages of CCTV**

The labor-saving advantages due to CCTV — an annual savings amounting to a possible $75,000 at the new Oyster Bay plant — result from the elimination of 2 men per shift from the operating floor. As the plant operates 24 hr a day, the total saving is 6 men. The saving is made possible because the plant supervisor is monitoring all critical operations and, upon observation of any need, he has within his immediate reach controls to effect automated responses throughout the plant.

There are various examples possible to show CCTV’s advantages. One is that of down time — the amount of time required to get an operation back on line after stoppage due to some difficulty. Without CCTV, a difficulty cannot be as reliably anticipated as with CCTV. CCTV will often spot a problem before it occurs, thus greatly reducing the task of getting the operation back in optimum working order. CCTV will observe slagging, the build-up of glassy material on walls to the point where it prohibits the progress and thorough burning of refuse, which is one of the most frequent of combustion problems. Large and incombustible objects — an automotive transmission, for example — which could jam the grates can be detected and removed before the damage has been done.

Important, too, is the fact that a more consistently efficient rate of speed for the moving of refuse from bin through furnace can be controlled through CCTV. Since the furnace operation is being monitored constantly, the supervisor is aware of changing burning conditions and holes in the fuel bed, and can promptly effect coordinating changes in the loading and stoker operation.

Further implementation of CCTV within an incinerator plant will someday include monitoring of chimney emission, as well as chimney maintenance, monitoring of weighing stations and traffic control and coordination of the plant.