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ABSTRACT

This paper reports an assessment of the education and training program needs stimulated by investment in cogeneration technology in Schuylkill County, Pennsylvania. (Cogeneration technology would convert raw culm, a byproduct of anthracite coal mining, into a fuel source for steam power generation.) After plant tours and interviews with plant personnel and educational institutions' staff, the study found that staff at a cogeneration plant require professional, craft, and technical knowledge. The professional knowledge is acquired either through a four-year degree program in a relevant discipline or a two-year associate degree program. Craft knowledge, acquired through vocational-technical programs or union training programs, is defined by skills and competencies unique to fabrication as well as system and facility maintenance and repair. Two kinds of technical knowledge are needed: (1) job-specific knowledge related to operational procedures, system parts and purposes, and troubleshooting procedures, all of which is currently provided to operational crews by a specialized start-up team composed of workers who are experts; and (2) generalizable knowledge of applications and theory that supports use of plant technology, including operational theories, systems design, technical and scientific processes, technical interface, and casualty issues involved with plant operation. The document also contains information on the typical staffing pattern and job descriptions. (CML)

Project Number Two

Assessment of Training Needs for Cogeneration Technology in Schuylkill County

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Institute

for

Research in Training and Development

The Pennsylvania State University
Division of Counseling and Educational Psychology
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Assessment of Training Needs for Cogeneration Technology in Schuylkill County

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Purpose

One by-product of anthracite coal mining is called culm, a low sulfur, high ash waste with a combustion rating of between 2500 to 4500 BTU/lb. Literally mountains of culm sit idle in the anthracite region of Pennsylvania. According to some estimates, there may be as much as one billion tons of culm in northeast Pennsylvania—enough to fire 20 power plants that could generate electricity for 440,000 homes for 50 years.

Raw culm has had few uses. Available technologies allow the BTU rating of raw culm to be raised to 6000 to 9000 BTU/lb. through processing to remove rock and other foreign materials. The result, in combination with advances in combustion technology, is an environmentally sound and economically viable fuel source for steam power generation.

The abundance of culm reserves in the anthracite mining region of Pennsylvania, along with recent legislative developments, has resulted in the planning and development of over 20 plants that will use fluidized bed combustion technology to burn culm to create steam and electricity for sale to utilities and industrial users. Because steam generated by these plants has so many potential uses, the process used in these plants is called cogeneration.

Cogeneration technology can be a significant revitalizing influence on the economically-depressed anthracite region of Pennsylvania. This technology could create short-term construction jobs, more permanent technical jobs at cogeneration plants, and sources of low-cost energy for industrial development. However, a technically trained workforce will be needed by these plants. Clearly, a proper response by education and training institutions is crucial so that people living in the anthracite region benefit from cogeneration technology projects.

In this paper we report an assessment of training needs for cogeneration technology in Schuylkill County, Pennsylvania. The purpose of the needs assessment was to identify education and training program needs stimulated by investment in cogeneration technology in Schuylkill County. This needs assessment was carried out in Schuylkill County, and it involved interaction among representatives from the cogeneration power industry, cogeneration industry consultants, and personnel from the Schuylkill Campus of The Pennsylvania State University.

The remainder of this report contains four sections. The procedures applied in this needs assessment are detailed in the next section. Presented in the third section are the education and training needs we identify. The fourth section contains recommendations for action and planning to meet workforce needs likely to be created by cogeneration technology in Schuylkill County.

Procedures

To obtain perspective about the employment and training needs for cogeneration technology in Schuylkill County, we visited two sites. We toured the Gilberton Power Company cogeneration project in West Mahanoy Township of Pennsylvania to became familiar with principles and practices of cogeneration technology. During this visit we met with personnel from the Gilberton Power Company, Bechtel Corporation, and Pyropower Corporation and with consultants to their operations. Our aims were to (a) identify the staffing pattern employed in a typical cogeneration plant and (b) determine the knowledge required by cogeneration plant staff involved in operations and maintenance.

We also met with personnel from the Schuylkill Campus of The Pennsylvania State University to examine current course offerings in electrical, electronics, and microcomputer technology and to discuss similar training opportunities available through public institutions in Schuylkill County. Our aim was to identify the current match between the needs for the maintenance and operations staff of a typical co-generation plant and the capabilities of the Schuylkill Campus to manage training for cogeneration technology in Schuylkill County.

Findings

Context

The Schuylkill County Industrial Development Authority (SCIDA) financed five cogeneration projects in 1985. Taken together, these projects are expected to yield of 215 net new jobs for Schuylkill County. Our needs assessment activity focused on the Gilberton Power Company, one of the five cogeneration projects funded by SCIDA in 1985. The Gilberton project is the only one of the five funded projects that is developed enough to consider its human resource needs. Use of our work, then, for planning of education and training requires the assumption that similar staffing patterns and requisite worker knowledge for all five cogeneration projects.

The Gilberton Power Company is engaged in a $131 million project to construct the John B. Rich Memorial Power Station in the West Mahanoy Township of Schuylkill County. When operational, the station will have a net production of 79.5 megawatts of electrical power for distribution through the Pennsylvania Power and Light Company. Two circulating fluidized bed boilers will generate 710,000 pounds of steam per hour, 50,000 pounds of which is so-called "process steam" to be used for drying coal and for potential sale to customers in a future industrial park near the plant.

The source of fuel for the power station is 25 million tons of anthracite culm and silt (fine coal particles) owned by Gilberton Power. The station will consume 57 tons of a silt and culm blend per hour. The culm will be cleaned and presized to 1/4" maximum by a processing plant run by an independent operator. The silt will be dried by an independent operator using process steam from the station. The station will produce approximately 21 tons of ash per hour. Ash will be collected in silos, processed, trucked to an ash pit that is an abandoned strip mine, and covered with soil, contoured, and reseeded.

Station Staffing Pattern

Displayed in Figure 1 is an organizational chart anticipated for the Rich Station.[1] Table 1 contains brief descriptions of positions for operations supervision, engineering, and operating labor for the station. Note that the position of Auxiliary Operator is the only position that can be classified as an entry-level position because it is the only position in the operations career ladder that does not require experience with steam power generation, although knowledge of steam generating plant theory is required.

Based on our discussion with Gilberton project personnel, access to the entry -level position of Auxiliary Operator may be gained by one of two methods. The first method is to be a member of the maintenance group with specialized skills and knowledge for a particular job or craft to which additional required base knowledge needed by operations technicians is added through formalized education and /or training. This combination of skills and experience would qualify a worker for the Auxiliary Operator's position in a typical plant staffing plan. The second method is to gain this desired base knowledge needed by technicians in the operations career ladder through formalized education or training.

Knowledge and Competencies Required

Three categories of knowledge are required for plant staff: professional, craft, and technical. The category of professional knowledge has two levels. The first level is defined by knowledge usually acquired through a professional or four-year degree in a relevant discipline. The second level typically is attained through a two-year or associate degree.

The category of craft knowledge is defined by skills and competencies unique to fabrication as well as system and facility maintenance and repair. Industry representatives believe that these basic desired skills should be possessed by graduates of quality vocational-technical progra However, industry representatives also believe that t skills could be acquired by workers who have mastered their craft through traditional union-sponsored training programs.

The category of technical knowledge is viewed as technical, theoretical, systems, and applications knowledge from a variety of disciplines related to the operations of the power plant. Industry representatives suggest that, although the maintenance group does not need to have the extent of the working technical knowledge required for operations personnel, maintenance group members need an understanding of the principles and operational procedures of the systems with which they interact.

Our discussions with the engineers at the Gilberton site and analysis of information we received about staff functions and scope of responsibilities suggest that the technical knowledge needed can be classified into two types. The first type of technical knowledge needed is job specific and is knowledge related to operational procedures, system parts and purposes, and troubleshooting procedures. The second type of technical knowledge is generalizable knowledge of applications and theory that supports use of plant technology.

The job specific technical knowledge currently is provided to the operational crews by a specialized startup team. The team typically is composed of personnel who are experts in various phases of plant operations and maintenance. The format used to train a new operations crews is a combination of structured training, job aids, self-instructional material and mentoring activities. The transfer of the needed knowledge to the new operations crews appears well planned and orderly. Additionally, a large volume of technical documentation is provided to the trainees.

[1] This chart, along with other estimates derived for positions, is provisional because the operating contractor, Bechtel North America Power Corporation, will not take over the project and will not specify labor needs for the facility for some time.

The generalizable technical knowledge required by operations staff focuses on the operational theories, systems design, technical and scientific processes, technical interface, and casualty condition issues involved with the plant operations. Currently, the industry model is to hire staff with this knowledge base from related fields and industries. There are two primary reasons for this practice. The first reason is that a surplus of this kind of expert knowledge is scarce within the cogeneration industry at the operations staff level. This is attributed to the newness of the technology and the existence of few operating plants. Second, there are no formalized education or training programs to teach the combination of subject matter content desired by the industry. Currently, an individual in the Schuylkill County area would have to pursue undefined combinations of elements from a variety of associate and/or four-year degree programs as well as vocational technical school course work to achieve the desired subject matter knowledge for an entry level position in the operations crew.

Our discussions with the industry representatives indicate that the subject matter knowledge should include the understanding of theories related to steam power and thermogeneration systems. In addition, operations staff should understand boiler systems theories and operations, turbomechanics, electric circuitry, and mechanical, hydraulic, and pneumatic systems. Last, strong knowledge of computer control systems is desired by industry representatives. This knowledge should include maintenance and troubleshooting protocols as well as control systems theory.

Recommendations

In our opinion, several components of a desirable educational and training program already exist to support the technical knowledge needs of the cogeneration industry in Schuylkill County and surrounding anthracite region of Pennsylvania. This is especially true in the areas of maintenance and operations of computer driven control systems. However, these and other appropriate course components should be formalized into a cohesive unit which blends theory and practice. The resulting program would prepare workers entry level operations staff positions in cogeneration plants and also would support the future career needs of these workers. Additionally, we believe that the Schuylkill Campus of the Pennsylvania State University has the capability to create and administer such a program effort. Consistent with these conclusions, we submit the following recommendations to respond to the identified need to develop a formal program to prepare workers with entry level skills and competencies for cogeneration operation staff positions.

We recommend that Schuylkill Campus of The Pennsylvania State University establish a strategy to address the current and future technical knowledge needs of the cogeneration industry. We recommend that this strategy be carried out in two phases.

The initial phase should focus on the development and implementation of a certificate program for cogeneration plant operation technicians. This phase should be completed by June, 1987. The second phase should be carried out within 6 to 9 months of the startup of the Rich Power Station.

The content of the certificate program should consist of a combination of courses from the current curriculum offerings in electronics and microcomputer technology programs at the Campus, along with selected non-credit technical courses at Schuylkill area vocational-technical schools. The entire focus of the content should address the areas of identified required technical knowledge outlined in the previous section of this report. Moreover, we recommend that a proposal be submitted to the Ben Franklin Partnership Program to fund this development activity. We suggest that the following major steps guide this development process:

1. establish an advisory group composed of members from the cogeneration industry,

2. submit to the advisory council for review and comment current courses which area vocational-technical schools and the Schuylkill Campus identify as appropriate candidates for inclusion in the certification program desired by the industry for targeted staff positions,

3. develop or modify courses or training programs to address the voids identified as a result of step 2,

5. identify resources and supporting funding to conduct instruction in the content areas which will constitute the certificate program. and

4. in collaboration with the cogeneration industry, develop an internship program to provide practicum experiences for students interested in this occupational area.

Paul W. Solomon, Resident Engineer for Gilberton Power Company, has indicated a strong endorsement of this effort, a desire to cooperate in the development of this certification program, and a willingness to commit reasonable personnel time to productive efforts to ensure a quality program.

Activities in the second phase should focus on performing detailed on-site work and task analyses of operation staff activities to identify further needs to be addressed through certificate course modification or further course development. In addition to identifying these needs, this analysis will evaluate to what degree and how this knowledge is actually needed and used. This evaluation should lead to the identification of organizations and/or plant specific training needs exist to which the Schuylkill Campus can plan to respond. It is recommended that a second Ben Franklin Partnership Act project proposal be developed to cover the costs of this extensive analysis activity. An additional outcome of this detailed analysis could be the identification future associate degree program needs to be developed and delivered at the Schuylkill Campus to continue its support of the cogeneration industry.

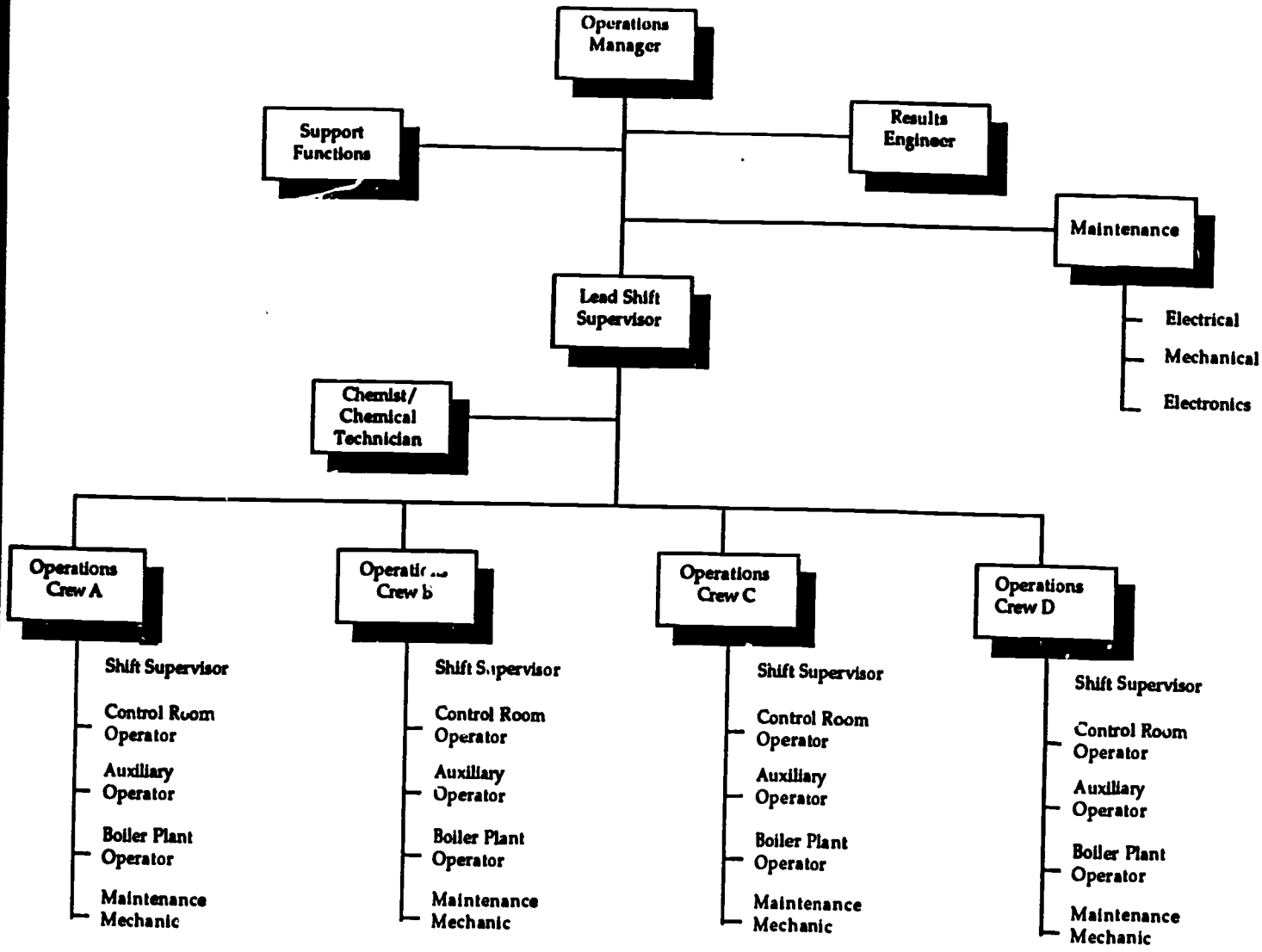

Figure 1. Anticipated Organization Chart for John B. Rich Memorial Power Station

Table 1. Operations Supervision, Engineering, and Operations Labor for the John B. Rich Memorial Station

Position	Description	Background
Operations Manager	Senior person assigned to the facility. Prepares and executes operating and maintenance plan; administers entire facility.	A licensed engineer with 15-20 years experience with steam power generation
Lead Shift Supervisor	Responsible to Operations Manager for operation of facility. Initial selection, hiring, training of operations personnel. Responsible for facility trip/casualty/ emergency critiques and corrective action formulation and implementation.	Extensive experience with steam power generation
Shift Supervisor	Report to Lead Shift Supervisor. Assigned to shift work to oversee shift operating crew.	Extensive experience with steam power generation
Results Engineer	Day shift only and backup for shift supervisory crew. Monitors and analyzes facility performance.	Engineering degree
Chemist/ Chemical Technician	Analyze and adjust facility water chemistry. Perform fuel analysis. Monitor emmissions.	Chemical technology degree or background
Control Room Operator	Responsible for moment-to-moment monitoring and adjustment of facility operations.	Licensed to operate power boilers and steam turbine generators
Auxiliary Operator	Reports to Control Room Operator. Hourly inspection of equipment, preoperation checks and alignment of equipment, and tag-out of equipment for maintenance.	General familiarity with steam power generation
Boiler Plant Operator	Reports to Control Room Operator for the moment-to-moment operation and adjustment (including startup and shutdown) of facility steam generating systems.	Experience with steam power generation