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**BEFORE THE STATE CORPORATION COMMISSION**

**OF THE STATE OF KANSAS**

Received
on

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by
State Corporation Commission
of Kansas

**DIRECT TESTIMONY**

**OF**

**FRANCIS W. SEYMORE**

**TLG SERVICES, INC.**

**ON BEHALF OF**

**WESTAR ENERGY**

**DOCKET NO.** 12-WSEE-112-RTS

## I. INTRODUCTION

**Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.**

A. My name is Francis W. Seymore. My business address is 148 New Milford Road East, Bridgewater, Connecticut 06752.

**Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?**

A. I am testifying on behalf of Westar Energy, Inc. and Kansas Gas and Electric Company (Westar).

**Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT POSITION?**

A. I am employed by TLG Services, Inc. (TLG), as Engineering Manager. TLG is a wholly owned subsidiary of Entergy Nuclear, Inc (ENI).

**Q. PLEASE BRIEFLY OUTLINE YOUR RESPONSIBILITIES AS ENGINEERING MANAGER AT TLG.**

A. I am responsible for the technical engineering consulting services in the areas of decontamination, decommissioning, waste management, and general engineering for nuclear and fossil-fueled generating stations.

**Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND.**

A. I graduated from the Rensselaer Polytechnic Institute with a Bachelor of Science degree in Nuclear Engineering in 1977. I received a Master of Engineering degree in Nuclear Engineering from Rensselaer in 1979.

**Q. PLEASE DESCRIBE YOUR PROFESSIONAL EXPERIENCE.**

A. I was employed by Nuclear Energy Services in Danbury, Connecticut, from 1979 until I left to join TLG in 1982. I joined TLG Engineering in November 1982 and TLG in January 1994. When TLG was purchased by ENI in September 2000, I was retained as Manager of Design Engineering for ENI.

**Q. DO YOU HOLD ANY PROFESSIONAL LICENSES?**

A. Yes. I am a Licensed Professional Engineer in the State of Connecticut (License 12775), and a Registered Professional Engineer in the Commonwealth of Pennsylvania (PE-033109-E).

**Q. HAVE YOU PREVIOUSLY FILED TESTIMONY AT ANY REGULATORY COMMISSION OR TESTIFIED BEFORE ANY COURT?**

A. Yes. I have filed testimony in the following rate cases or proceedings:

- In April of 2010 I prepared testimony for submission to the US Tax Court for Entergy Nuclear on the decommissioning costs for the Pilgrim Nuclear Plant, Entergy Corporation v. Commissioner, Docket No. 10557-08, but ultimately did not need to be called at the trial due to an agreement between the parties.
- In September of 2008 I was deposed before the Texas Public Utilities Commission for Southwestern Public Service Company on estimating the dismantling costs for their 28 fossil generating stations in Texas and New Mexico, PUC Docket No. 35763.
- In May 2006, I testified before the California Public Utilities Commission, for Pacific Gas and Electric Company on the Nuclear Decommissioning Costs 2005 Triennial Proceedings, Application 05-11-009.
- In March 2004, I was deposed before the U.S. Department of Justice for Exelon Generation Company on decommissioning cost estimates and their relation to spent

fuel disposition, Commonwealth Edison Company v. United States, Case No. 98-621C.

- In January 1990, I testified before the New York State Public Service Commission, for Rochester Gas & Electric Company on the Robert E. Ginna Power Plant rate case, Docket 89-E-166, 167 and 168.
- In December 1990, I testified before the Alabama Public Service Commission, for Alabama Power Company on the Joseph M. Farley Nuclear Plant, Docket U3295.
- In August 1989, I testified before the North Carolina Utilities Commission, for Duke Power Company, Carolina Power & Light, and Virginia Power Company on decommissioning costs and waste volumes for decommissioning the Catawba Nuclear Station and Brunswick Steam Electric Plant, Docket E-100, Sub 56.

**Q WHAT EXPERIENCE DO YOU HAVE WITH THE PROCESS OF DECOMMISSIONING AND THE ESTIMATION OF DECOMMISSIONING COSTS?**

A. I have extensive experience in preparing decommissioning cost studies. I am the chief architect of TLG's decommissioning cost model DECCER, which has been used in preparing over 200 decommissioning cost estimates over the past 20 years.

I have been involved in all of the decommissioning cost estimates performed for the Wolf Creek Generating Station since 1988.

I was responsible for several aspects of the detailed engineering and planning of the Shippingport Station Decommissioning Project from 1981 to 1982. Shippingport was a 72 Megawatt ("MW") light water breeder reactor and the first commercial reactor in the U.S.

I was on site at the Three Mile Island Unit 2 recovery and decommissioning program from 1982 to 1983, where I assisted in the detailed planning for reactor disassembly and removal of the damaged reactor core internals.

TLG developed the estimates, contractor bid specifications, contractor selection, and provided on-site oversight of dismantling activities for the coal-fired Comal Power Plant owned by the Lower Colorado River Authority in New Braunfels, Texas.

TLG assisted Northern States Power Company in 1988/1989 with the preparation of the decommissioning plan for the Pathfinder Atomic Power Plant. Pathfinder, located in Sioux Falls, South Dakota, was a 60 MW reactor initially placed in SAFSTOR, a mothballing option for decommissioning as recognized by the U.S. Nuclear Regulatory Commission ("NRC"), (a safe storage condition), after an abbreviated operating life. I assisted in preparing detailed cost and schedule, and vessel activation estimates. I analyzed the reactor vessel to be used as its own shipping container, and prepared the decommissioning plan using the NRC's DECON method in support of plant decommissioning. The DECON method is the prompt dismantling option for decommissioning as recognized by the NRC.

TLG worked with the Long Island Lighting Company in planning for the decommissioning of the Shoreham Nuclear Power Station. I supervised the preparation of the detailed reactor vessel activation analysis, cost estimates, schedules, management organization, waste volume estimates and preparation of a draft decommissioning plan.

In 1990, TLG was selected by Cintichem, Inc. (a subsidiary of Hoffman LaRoche) as a Co-Manager of the decommissioning of a 10-MW thermal radio isotope production reactor with associated hot cells and facilities. I prepared a reactor core activation analysis, and assisted in the development of a cost and schedule estimate for the project.

TLG has been involved in the engineering and planning activities associated with the decommissioning of the Yankee Rowe, Trojan Nuclear Plant, Rancho Seco Nuclear Generating Station, and Big Rock Point nuclear units. I supervised the activation analyses and preparation of decommissioning alternative cost and schedule estimates. TLG also supported Portland General Electric in the detailed planning required for completing the removal and disposal of the reactor vessel and the highly radioactive internal components.

I was also the project manager for performing dismantling cost estimates for the fossil fuel units of Westar.

**Q HAVE YOU PREPARED OR COAUTHORED ANY STUDIES AND REPORTS ON DECOMMISSIONING COST ESTIMATING AND TECHNOLOGY?**

A. Yes. I was a contributor to the "Decommissioning Handbook" (DOE reference number DOE/EV/10128-1) for the U.S. Department of Energy ("DOE"). The Handbook reported then current decommissioning technology (as of 1980), including decontamination, piping and component removal, vessel segmentation, concrete demolition, cost estimating and environmental impacts.

At TLG in 1986, I was a major contributor to the "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates" (Publication AIF/NESP-036) for the Atomic Industrial Forum ("AIF"), National Environmental Studies Project ("NESP"). The Guidelines identify the elements of costs to be included in the estimation of decommissioning activities for each of the principal decommissioning alternatives. Specific guidance in cost estimating methodology and reference cost data is provided in this study. The major objective of this study is to provide a basis for consistent cost estimating methodology.

TLG also prepared a study in 1986 entitled, "Identification and Evaluation of Facilitation Techniques for Decommissioning Light Water Power Reactors" (Publication No. NUREG/CR-3587) for the NRC. The study evaluated the costs and benefits of techniques to reduce occupational exposure and waste volume from decommissioning. In addition, TLG prepared the Decommissioning Plan and Environmental Report ("ER") for Dresden Unit 1, and the ER for Indian Point Unit 1.

I have been involved in the preparation of dismantling estimates for over 200 fossil units throughout the United States. I have also been involved in the preparation of site-specific decommissioning studies for approximately 90 percent of the nuclear units in the United States.

## II. ASSIGNMENT

**Q. WHAT IS YOUR ASSIGNMENT IN THIS PROCEEDING?**

A. I am presenting the results of the TLG study "Dismantling Cost Study for Abilene CT 1, Hutchinson CT 4, Murray Gill Units 1 & 2, Neosho Unit 3, Tecumseh CT 1 & 2, Generating Units", TLG Document W21-1645-001, Exhibit FWS-1. This study provides cost estimates for the dismantling of selected Westar fossil fueled electric generating facilities, consisting of 7 separate units on 5 sites in Kansas, with a combined generating capacity of 401 MW.

**Q. WHAT IS COVERED BY THE TERM "DECOMMISSIONING," AS USED WITH REFERENCE TO A GENERATING STATION?**

A. Decommissioning is the planned and orderly retirement of a generating station. Upon retirement, the facility may either be rendered safe indefinitely (through on-going maintenance, repair and security measures), or dismantled. The TLG estimate assumed that the units in question would be dismantled.

**Q. PLEASE DESCRIBE THE PLANT FACILITIES ADDRESSED BY YOUR ESTIMATED DISMANTLING COST STUDY.**

A. The units in the study consist of both combustion turbines and natural gas fired boiler steam generating plants. The scope of the study includes the dismantling of the power generating systems and enclosures, fuel handling and storage systems and structures, cooling towers (when present). The cost estimate for dismantling also includes removal of asbestos (where present). Structures are removed to three feet below grade. The costs to control erosion (establish ground cover) is also included. The costs for conducting an environmental monitoring program after dismantling of the plant site are included.

**Q. PLEASE SUMMARIZE THE COSTS IDENTIFIED IN THE DISMANTLING STUDY.**

A. Dismantling and demolition of the selected 7 Westar units is estimated to cost approximately $20,756,000 (2011 dollars). The total costs include a credit for the scrap metal generated and sold during the project. A summary of the cost by unit is presented in Table 1

.

**Table 1**
**Westar Summary of Dismantling Costs**
(Thousands of 2011 Dollars)*

| Station | Unit | MWe rating | Type | Fuel | In Service | Station Cost |
|---|---|---|---|---|---|---|
| Abilene | 1 | 77.4 | Simple Cycle Combustion Turbine (CT) | natural gas | 1973 | 682 |
| Hutchinson | 4 | 85.5 | CT | oil | 1975 | 750 |
| Murray Gill | 1 | 48 | Steam Boiler | natural gas/oil | 1952 | 10,850 |
| | 2 | 66 | Steam Boiler | natural gas/oil | 1954 | |
| Neosho | 3 | 66 | Steam Boiler | natural gas/oil | 1954 | 7,597 |
| Tecumseh | 1 | 28.8 | CT | natural gas/oil | 1972 | 877 |
| | 2 | 28.8 | CT | natural gas/oil | 1972 | |
| **Study Totals** | **7** | **401** | | | | **$20,756** |

*Note: Columns may not add due to rounding

**Q. WAS THE DISMANTLING STUDY PREPARED UNDER YOUR DIRECTION AND SUPERVISION?**

A. Yes. I developed the methodology used by TLG to estimate the costs to dismantle fossil-fueled power plants. During the preparation of the study, I was the Project Manager and provided guidance and interpretation to the TLG staff on how to estimate specific elements of cost. I reviewed the results of the estimate to ensure the results were reasonable and consistent with the design of the plant. Finally, I supervised the preparation of the report.

## III. METHODOLOGY

**Q. WHAT TYPES OF COSTS ARE ANALYZED IN A DISMANTLING STUDY?**

A. There are two major types of costs included and analyzed in a dismantling study: activity-dependent costs and period-dependent costs.

Activity-dependent costs are those associated with the physical work of removing piping, components and structures and transporting and disposing of the same. These costs represent labor, materials, and special services (subcontracted) costs associated with the work crews activities (hence, activity-dependent costs). The summation of the durations to perform these activities when properly sequenced provides the overall schedule for the project.

Period-dependent costs are those elements whose value is based upon the duration of a work activity. The project is divided into three periods of work activity:

1. Characterization, Planning and Preparations, and Asbestos Abatement;
2. Systems and Structures Dismantling; and
3. Site Restoration.

Period-dependent costs are adjusted to reflect the work activities or resources required in each period.

**Q. WHAT PROCESS WAS USED FOR DEVELOPING THE DISMANTLING COST STUDY?**

A. The general approach in assembling the estimate was to develop a site-specific cost for each unit, based on a unit-specific equipment and building materials inventory. The inventory of components designated to be removed as part of the dismantling program was established using site walk-downs (including discussions with Westar operations and maintenance staff at each plant), and inventory data from TLG's previous work on similar fossil plants.

The systems and structures inventories for the combustion turbine sites were developed solely from the site walk-downs.

Activity dependent costs were estimated by applying the appropriate unit cost factor against the unit inventory. The unit cost factors consider local costs of labor, working conditions, and costs of equipment and consumables.

Period-dependent costs were estimated by applying the work activity duration against the monthly costs for owner and contractor management, shared equipment, work site security, and similar types of expenses.

Contingency was added to the estimate to account for unpredictable project events.

A credit was applied against the project estimate for expected scrap metal cost recovery. Scrap credit was estimated by applying the inventory against unit prices for various types of scrap metals generated during dismantling.

**Q. WHAT METHODOLOGY WAS USED TO PREPARE THE DETAILED COST ESTIMATE?**

A. The methodology used to develop the detailed cost estimates for the Reference Plants followed the basic approach presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," the DOE "Decommissioning Handbook," and the American Association of Cost Estimators paper "A Methodology for Determining the Cost of Dismantling Fossil-Fueled Electric Power Plants." Obviously, concerns that are unique to a nuclear power plant (e.g. radiation protection) are not necessary for fossil power plants and, therefore, none were included in the study. However, the basic methodology, sometimes called the "bottoms-up" approach, which is widely accepted by the electric power industry and regulatory commissions, throughout the United States, including the Kansas Corporation Commission (Commission). The dismantling of non-contaminated systems and structures are addressed in the aforementioned Guidelines and are directly applicable to the dismantling of fossil-fuel power plants.

**Q. HOW WAS THIS METHODOLOGY APPLIED TO THE WESTAR COST ESTIMATE?**

A. The aforementioned references use a unit cost factor method for estimating decommissioning activity costs to standardize the estimating calculations. Unit cost factors for activities such as concrete removal ($ per cubic yard), steel removal ($ per ton), and cutting costs ($ per inch cut) were developed based on the labor cost information provided. Consumable material and equipment rental costs (crane and truck rental, operating costs for heavy equipment, torch cutting gas consumption, etc.) were taken in large part from R.S. Means, "Building Construction Cost Data 2011." The activity-dependent cost for removal, shipping and disposal were estimated using the item quantity (cubic yards, tons, inches, etc.) developed from plant drawings and inventory documents. The activity duration critical path derived from such key activities as boiler removal, turbine removal etc., was used to determine the total dismantling program schedule.

The program schedule is used to determine the period-dependent costs such as program management, administration, field engineering, equipment rental, and security.

In addition, costs were included for heavy equipment rental or purchase, safety equipment and supplies, energy costs, permits, and insurance. The activity-dependent and period-dependent costs were added to develop the total dismantling costs. Contingency was added to allow for the cost impact of unpredictable project events. The total of the activity and period-dependent costs plus contingency, less scrap credit, results in the total project cost.

**Q. FOR THE PURPOSES OF THE ESTIMATE, WHEN DID YOU ASSUME THE UNITS AT EACH SITE WOULD BE DISMANTLED?**

A. TLG did not make any assumptions regarding the timing of the dismantling program. We assumed dismantling of each unit would occur after its retirement.

**Q. WHAT ARE THE MAJOR ASSUMPTIONS THAT YOU USED TO DEVELOP THE DISMANTLING ESTIMATE FOR THE WESTAR STATIONS?**

A. The following major assumptions were used in developing the dismantling estimate.

1. Estimated costs are stated in 2011 dollars. Escalation/inflation of the costs over the remaining operating life is not included.
2. The dismantling process will be an engineered process rather than wrecking ball demolition. Concerns for worker safety reinforce the need for a controlled approach. Accordingly, all large components are assumed to be lowered to grade for

additional disassembly. The steel support structures and other site building structures are dismantled from the top. All plant equipment and their supporting mechanical and electrical systems are removed by disassembly and segmentation where necessary.

3. The demolition will be performed by a Dismantling Operations Contractor who will provide adequate staff and equipment to complete the dismantling.

4. Asbestos will be removed prior to the start of dismantling. Asbestos removal costs include costs for removal of asbestos containing roofing material on the boiler house and turbine buildings, removal of asbestos containing exterior paneling on the office and service buildings, and removal of the condenser water box mastic coating. Note that the newer stations are assumed to have very little asbestos, and the cost estimates for those stations reflect this assumption.

5. Structural steel, piping, electrical cable, etc., will be credited for scrap value. Plant equipment is assumed to have no value as salvage.

6. The estimate to dismantle the station does not address the value of the land.

7. On-site fuel inventories will be used and/or removed prior to start of dismantling.

8. Acids and caustics will be removed. Ion exchangers and filters will also be emptied in preparation for dismantling.

9. Stores, spare parts, bulk chemical supplies, gas storage containers, laboratory equipment, office furniture, etc., will be removed by the owner in preparation for dismantling.

10. Station transformer oil is assumed to be Polychlorinated Biphenyl (PCB) free. Lubrication and transformer oils are drained and removed from site by a waste disposal contractor.

11. Essential systems (air, water, electrical, fire water, etc.), required to support dismantling operations will remain in service throughout the project until replaced by temporary services.

12. Turbine building crane, miscellaneous hoists, and trolleys will remain in service to support dismantling until no longer needed.

13. Structures and foundations will be removed to three feet below grade, with any resulting voids back-filled to grade level.

14. The concrete structures will be blasted to the ground and broken into rubble, and the foundations control-blasted to break the concrete in place so that groundwater drainage is provided. The rubble will be used as clean fill; excess concrete rubble will be disposed of off site as construction debris.

15. The dismantling of the electrical equipment terminates at the switchyard. The switchyard itself is left intact.

16. The site will be graded; however, no effort will be made to restore the original contour of the land. Ground cover will be established for erosion control. Structural fill is brought from off site for voids in excess of the available concrete rubble for backfill.

17. Contingency is applied to project cost total.

**Q. WHAT WERE THE INPUTS TO THE COST ESTIMATING MODEL, AND HOW WERE THESE VALUES DETERMINED?**

A. The estimate used the following input data:

**Craft Labor Costs** – Westar Energy provided fully-burdened craft labor rates for commonly-used trades, such as operating engineer, millwright, truck driver, etc.

**Staff Costs** – Westar Energy provided salary information, and overhead and benefit rates, for a variety of current plant positions.

**Systems Inventory** – A site-specific inventory was established using site walk-downs, plant drawings, and in certain instances, revising a previously developed inventory for a similar plant (reference plant), to reflect differences between the Westar unit and the reference plant. Where inventories from a reference plant were used as a starting point, differences were incorporated into the Westar unit inventory, in essence creating a site-specific inventory for the Westar unit. To account for any difference in size between the reference inventory and the Westar unit a size adjustment to the reference unit inventory was applied.

**Structural Inventory** – In a similar fashion to the system inventory, the structural steel, concrete, and other building data points were first gathered from the data for similar units in TLG's database. This information was then adjusted, based upon the information TLG personnel gathered during the site walk downs. Site plot plans were reviewed to obtain acreage and other site restoration quantities.

**Other costs** – R.S. Means provided rates for such items as small tool allowances, permits, fees, insurances, etc.

**Q. WHAT YEAR WAS USED FOR THE COST BASIS FOR THE ESTIMATES?**

A. In all cases, the cost basis for the estimate is 2011.

**Q. HOW DID YOU ARRIVE AT THE VARIOUS CONTINGENCY PERCENTAGES THAT YOU APPLIED?**

A. The AIF Guidelines previously mentioned suggests a 15% contingency for clean systems and structures removal activities. Therefore, the estimate uses a 15% contingency for all cost elements with the exception of asbestos remediation. Since the regulatory requirements imposed on asbestos remediation efforts are similar to those working in a radioactively contaminated environment, the Guidelines suggests a 25% contingency for the removal of radioactively contaminated systems; therefore a 25% contingency was applied to asbestos removal activities.

**Q. WHAT ARE THE MAJOR DIFFERENCES BETWEEN NUCLEAR DECOMMISSIONING AND DISMANTLING FOSSIL POWER PLANTS?**

A. The major difference is the presence of radioactivity at a nuclear power plant. In order to decommission a nuclear plant, this radioactive material must be removed to levels consistent with the regulatory requirements. Once this has been completed, the demolition of the remaining systems and structures is similar to the scope of a fossil-fuel power plant dismantling project.

**Q. DOES YOUR EXPERIENCE IN THE DECOMMISSIONING OF NUCLEAR POWER PLANTS AID IN THE CONDUCT OF A SITE-**

**SPECIFIC DISMANTLING STUDY OF A FOSSIL-FUELED POWER PLANT?**

A. Yes. The parallelism in approach between nuclear plant decommissioning and fossil plant dismantling enables us to rely on the field experience from nuclear decommissioning to prepare fossil plant studies. In particular, the following major areas of planning and estimating exhibit similar characteristics.

1. Site Characterization

   The process to identify hazardous and toxic materials is similar for nuclear and fossil-fueled power plants.

2. Removal of Hazardous Material (Asbestos)

   The effort required to remove asbestos-containing materials in nuclear and fossil plants is similar.

3. Removal of Clean Equipment and Structures

   The techniques used to remove systems and structures components are expected to be the same.

4. Owner and Contractor Staff

   Identification of utility and decommissioning (dismantling) staffing composition and levels follows the same process in both types of units. The specific job functions and number of personnel will differ but the logic is the same.

5. Scheduling

Schedule for both the demolition of the remaining systems and structures in nuclear decommissioning and fossil dismantling projects rely on estimating the number of craft workers that can work safely and efficiently.

6. Contingency

Contingency is a cost allowance for field-related problems that are likely to occur. These problems include tool and equipment breakdown, late deliveries of supplies and equipment, and adverse weather. These field problems occur in both nuclear and fossil plant dismantling. Work removing radioactive materials incurs a higher contingency.

In summary, the demolition of the remaining systems and structures in nuclear plant decommissioning experience is directly applicable to fossil plant dismantling.

**Q. IS IT POSSIBLE THAT FUTURE CHANGES IN TECHNOLOGY AND REGULATION COULD AFFECT THE DISMANTLING COSTS?**

A. Yes. The TLG cost estimate was based on current technology and existing regulations. No provision is made to adjust for cost changes associated with future changes in dismantling technology and regulations. It is my recommendation that Westar Energy thoroughly review this estimate periodically and revise it, if necessary, to account for cost changes as influenced by future technology and regulations.

**Q. HOW OFTEN SHOULD SUCH A REVIEW OCCUR?**

A. I understand that Westar performs and submits a new depreciation study to the Commission every five years. In the absence of extraordinary events that necessitate an earlier review, the decommissioning plan should remain reasonably accurate if it is revisited each time a new depreciation study is performed.

## IV. CONTINGENCY

**Q. WHAT IS THE BASIS FOR CONTINGENCY?**

A. The purpose of the contingency is to allow for the costs of high probability program problems, where the occurrence, duration, and severity cannot be accurately predicted and have not been included in the basic estimate. The inclusion of contingency in cost estimation for both construction and dismantling is well accepted. The Association for the Advancement of Cost Engineering International (in its Cost Engineer's Notebook) defines contingency as follows:

> Contingency - specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur.

Past dismantling and decommissioning experience has shown that problems are likely to occur and may have a cumulative impact. These problem areas include:

| | |
|---|---|
| Schedule slippages - | leading to crew overtime payments and/or project extensions |
| Weather delays - | loss of productivity, overtime, slippages |
| Labor strikes - | loss of productivity, slippages |
| Workers injuries - | production interruptions, addi-tional safety training, workers compensation claims, and pos-sible increased insurance pre-miums |
| Material shipping - | rescheduling of activities, inefficiencies in production, |
| Equipment breakdowns - | rescheduling of activities, out-of-scope back charges from subcontractors |
| Regulatory inspections - | insurance inspectors, OSHA inspectors, federal and state Environmental Protection Agency inspectors, state building inspectors |
| Hazardous materials - | special handling requirements beyond planned requirements |

A more extensive discussion of contingency is included in the AIF/NESP-036 Guidelines Study (Chapter 13) referred to earlier. In that study, individual contingencies ranged from 10% to

75%, depending on the degree of difficulty judged to be appropriate from actual experience. The overall contingency, when applied to the appropriate components of nuclear plant decommissioning costs, results in an average contingency for nuclear plants of up to 25%.

For fossil plant dismantling, the absence of radioactive materials and their attendant potential problems simplifies the dismantling process. Individual activity contingency estimates for fossil-fueled power plants usually are in the range of 15%, and greater if there are significant quantities of asbestos on site. Independent of our preparation of this estimate for Westar Energy, R.S. Means, "Building Construction Cost Data 2011," suggests that a 15% contingency factor (for projects that are in the schematic stage) be used.

## V. SITE RESTORATION

**Q. ARE THERE ANY REGULATIONS OR CODES APPLICABLE TO DISMANTLING?**

A. Yes. The International Building Code, widely adopted by most states, requires that retired structures may not be left in an unsafe condition. Specifically, Section 115.1, "Conditions," states:

> Structures or existing equipment that are or hereafter become unsafe, insanitary or deficient because of inadequate means of egress facilities, inadequate light and ventilation or which constitute a fire hazard, or are otherwise dangerous to human life or the public welfare, or that involve illegal or improper occupancy

> or inadequate maintenance, shall be deemed an unsafe condition. Unsafe structures shall be taken down and removed or made safe, as the building official deems necessary and as provided for in this section. A vacant building that is not secured against entry shall be deemed unsafe.

(Emphasis Added)

A retired power plant appears to fit this definition of an unsafe structure that must be taken down and removed or made safe and secure.

**Q. WHY IS DISMANTLING AFTER A POWER PLANT IS TAKEN OUT OF SERVICE THE APPROPRIATE ALTERNATIVE?**

A. Precluding reconstruction, a retired fossil facility poses hazards including large interior open areas, pits, shafts and underground tunnels. With many of the plant services removed from service, the structures would be unheated, dark, littered with concrete rubble and structural debris obstructing means of egress. Condensation and groundwater intrusion and bird infiltration would soon create hazardous conditions, promoting unsanitary biological infestations, accelerating corrosion and general facility deterioration. A dedicated and systematic maintenance program is necessary to maintain the facility in a "safe" condition. Security measures are necessary to limit the liability inherent in casual or deliberate intrusion by the public. These maintenance and surveillance programs are expensive.

The steel and concrete or brick structures at fossil sites were not designed to prevent deliberate intrusion. Large glass windows, sheet metal siding, loading ramps and multiple ingress points allow easy entry into the station confines. Visitation of older, shutdown units has conclusively demonstrated both the speed and effects of facility deterioration. Such deterioration includes broken windows, leaking roofs, torn or damaged siding, obstructed stairwells with poor egress, and unsanitary conditions caused by the effects of weather, corrosion, ground water intrusion and vermin.

The alternative to perpetual caretaking and site surveillance is to dismantle the site as soon as practical. This activity is the most cost-effective when included within the schedule for site remediation, due to resources available on-site and the expected condition of the facilities.

The Commission has accepted TLG's cost estimate for decommissioning the Wolf Creek Generating Station. That estimate includes dismantling of the decommissioned structures, following license termination (at the nuclear power plant), as an appropriate measure to protect public health and safety. The same safety concerns exist at retired fossil power stations, and for this reason TLG recommends dismantling fossil power plant structures.

## VI. SALVAGE AND SCRAP

**Q. HOW WAS SCRAP OR SALVAGE CREDIT INCLUDED IN THE OVERALL ESTIMATE?**

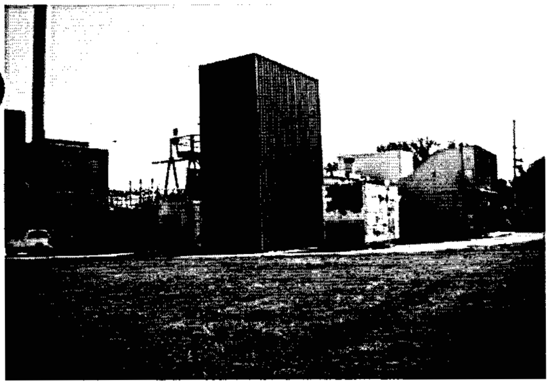
A. Credit for carbon steel, stainless and high-chrome steel, copper-nickel, and copper scrap is included in the fossil estimates based on published scrap values. No credit, other than their scrap value, was included for salvage of any components because these components will be of an obsolete design and likely will be in poor condition by the time these plants are dismantled. As such, these materials were considered as scrap.

## VII. CONCLUSION

**Q. WAS EXHIBIT FWS-1 PREPARED BY YOU OR UNDER YOUR DIRECT SUPERVISION AND CONTROL?**

A. Yes.

**Q. THANK YOU.**



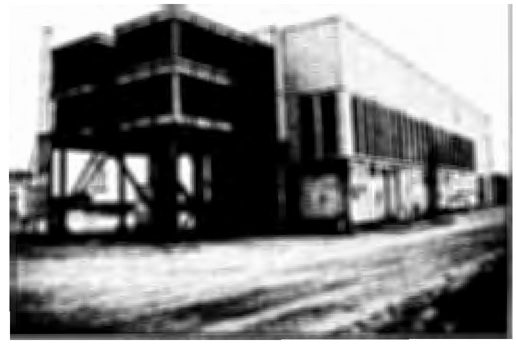


**EXHIBIT FWS-1**

# DISMANTLING COST STUDY
## for
**ABILENE CT 1**

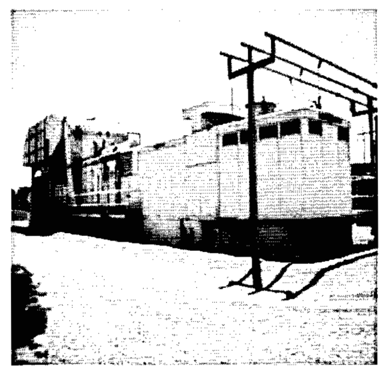
**HUTCHINSON CT 4**

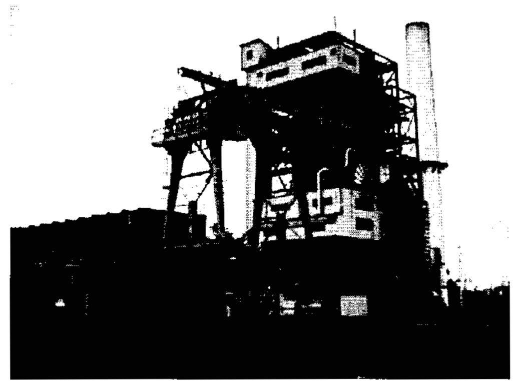
**MURRAY GILL UNITS 1 & 2**

**NEOSHO UNIT 3**

**TECUMSEH CT 1 & 2**

## GENERATING UNITS





*prepared for*

**Westar Energy**

*prepared by*

**TLG Services, Inc.**
*An Entergy Company*
148 New Milford Road East
Bridgewater, CT

**July 2011**

# APPROVALS

| | | |
|---|---|---|
| Project Manager | Francis. W. Seymore | 7/26/11<br>Date |
| Project Engineer | Benjamin J. Stochmal | 7/26/11<br>Date |
| Technical Manager | Geoffrey M. Griffiths | 7/26/11<br>Date |

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| Rev. No. | CRA No. | Date | Item Revised | Reason for Revision |
|---|---|---|---|---|
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## EXECUTIVE SUMMARY

This report, prepared by TLG Services, Inc. (TLG), provides estimated costs for the complete dismantling of the following electric generating units:

- Abilene Combustion Turbine 1
- Hutchinson Combustion Turbine 4
- Murray Gill, Units 1 and 2
- Neosho, Unit 3
- Tecumseh Combustion Turbine 1 & 2

Westar Energy, Inc. and Kansas Gas and Electric Company (collectively, Westar) owns these stations. All of the stations are located in Kansas.

The dismantling estimate includes the cost of removing the power generating equipment such as boilers, turbine generators, fuel handling equipment, system equipment, and structures for each of the above-referenced stations. The electrical switchyards are assumed to remain in place and are not included in the estimate.

The scope of the dismantling estimate includes the following significant cost elements:

- Isolation of the units in preparation for safe dismantling (ensuring systems are de-energized to ensure a safe dismantling environment)
- Abatement of asbestos containing materials prior to dismantling (where applicable)
- Labor, equipment, and material costs associated with the removal and disposition of all installed equipment
- Labor, equipment, and material costs associated with the demolition and disposition of buildings and foundations (to a depth of 3 feet below grade)
- Demolition contractor's on-site management, engineering, safety, and administrative staff
- Demolition contractor's expenses, including profit, insurance, permits, and fees
- Owner's on-site management, oversight, and security staff
- A cost credit associated with the disposition of scrap metals
- Cost contingency
- Ongoing environmental monitoring after the completion of the dismantling and demolition

The general approach to developing these estimates was to develop a site-specific estimate for each unit, based on a site-specific equipment and building materials inventory. The site-specific inventory was established using site walk-downs, plant drawings, and in certain instances, revising a previously developed inventory for a similar plant (reference plant), to reflect differences between the Westar unit and the reference plant. Where inventories from a reference plant were used as a starting point, differences were incorporated into the Westar unit inventory, in essence creating a site-specific inventory for the Westar unit. To account for any difference in size between the reference inventory and the Westar unit a size adjustment to the reference unit inventory was applied.

This cost estimate is prepared by applying unit cost factors (developed for each inventory item from prior dismantling experience or similar related experience) against the station specific inventory. Costs for project management, shared equipment and consumables, and similar types of costs are estimated on a period-dependent basis (i.e., the magnitude of the expense depends, in part, on the duration of the project and the types of activities taking place). While equipment salvage is not included, the potential value of scrap from materials generated in dismantling the boilers, plant components, and building structural steel is included as a credit in the dismantling cost estimate. Contingency is provided within this estimate to account for unpredictable project events.

This estimate includes the costs to remove all structures associated with the unit on the site to a nominal level of three feet below grade. Concerns for worker safety reinforce the need for a controlled approach. The cost estimates reflect demolition by controlled/engineered dismantling.

Limited site landscaping includes grading and seeding for drainage and erosion control.

The total dismantling costs, expressed in thousands of 2011 dollars, are provided at the end of this section.

## SUMMARY OF DISMANTLING COSTS

(All costs are in thousands of 2011 dollars)

| Station | Unit | MWe rating | Type | Fuel | In Service | Station Cost |
|---|---|---|---|---|---|---|
| Abilene | 1 | 77.4 | Combustion Turbine, Simple Cycle (CT) | Natural Gas/Oil | 1973 | 682 |
| Hutchinson | 4 | 85.5 | CT | Oil | 1975 | 750 |
| Murray Gill | 1 | 48 | Steam Boiler | Natural Gas/Oil | 1952 | 10,850 |
| | 2 | 66 | Steam Boiler | Natural Gas/Oil | 1954 | |
| Neosho | 3 | 66 | Steam Boiler | Natural Gas/Oil | 1954 | 7,597 |
| Tecumseh | 1 | 28.8 | CT | Natural Gas/Oil | 1972 | 877 |
| | 2 | 28.8 | CT | Natural Gas/Oil | 1972 | |
| **Totals** | | **401** | | | | **$20,756** |

# 1. INTRODUCTION

## 1.1 OBJECTIVE OF STUDY

The objective of this dismantling cost study prepared by TLG Services is to present an estimate of the costs to dismantle the designated Westar Energy's (Westar) fossil-fuel generating units in Kansas. This study is not intended to be a dismantling plan, but rather a cost estimate prepared to support current financial planning for future dismantling.

## 1.2 GENERATING UNIT DESCRIPTIONS

**Abilene CT 1** is a simple cycle combustion turbine located at Abilene Energy Center, 1008 2000 Avenue, Abilene, Kansas. The generating unit is a Westinghouse air-cooled, gas-fired, combustion turbine rated at 77.4 MWe. The unit went operational in 1973.

**Hutchinson CT 4** is a simple cycle combustion turbine located at Hutchinson Energy Center, 3200 E 30th Avenue, Hutchinson, Kansas. The generating unit is a Westinghouse hydrogen-cooled, oil-fired, combustion turbine rated at 85.5 MWe.

**Murray Gill Unit 1 & Unit 2** are natural gas/oil fired Foster Wheeler steam boilers. Unit 1 has a General Electric generator rated at 46 MWe; Unit 2 has a Westinghouse generator rated at 66 MWe. The units are located at the Murray Gill Energy Center, 6100 W 55th Street, Wichita, Kansas. The units went operational in 1952 and 1954.

**Neosho Unit 3** is a natural gas/oil fired Combustion Engineering steam boiler with a General Electric generator; the unit is rated at 66 MWe. It is located at 2365 22000 Road, Parsons, Kansas. The unit went operational in 1954.

**Tecumseh CT 1 & 2** are simple cycle combustion turbines located at Tecumseh Energy Center, 5850 SE 2nd St, Tecumseh, Kansas. The twin generating units are General Electric air-cooled, oil-fired, combustion turbines rated at 28.8 MWe each. The units went operational in 1972.

## 1.3 SCOPE

The scope of the dismantling estimate includes the following significant cost elements:

- Preparation for safe dismantling; including hazardous materials characterization for such items as ACM (asbestos-containing materials), lead, mercury, PCBs, hydrocarbons in soil, etc., and isolation of the units in preparation for safe dismantling (e.g. ensuring systems are de-energized, fuel and chemical storage tanks are drained and cleaned, etc. (where applicable).
- Abatement of ACM prior to dismantling (where applicable)
- Labor, equipment, and material costs associated with the removal and disposition of all installed equipment
- Labor, equipment, and material costs associated with the demolition and disposition of buildings and foundations
- Demolition contractor's on-site management, engineering, safety, and administrative staff
- Demolition contractor's expenses, including insurance, permits, and fees.
- Owner's on-site management, oversight, and security staff
- A cost credit associated with the disposition of scrap metals
- Cost contingency
- Ongoing environmental monitoring of the facilities after the completion of the dismantling and demolition

Costs are provided for each station, identified by significant cost element. The cost per station includes the costs for dismantling the generating unit and the common station facilities. Costs are provided in 2011 dollars.

## 1.4 GENERAL APPROACH

The general approach in assembling the estimate was to develop a site-specific cost for each generating unit located at the station, based on a unit-specific equipment and building materials inventory. The inventory of components designated to be removed as part of the dismantling program was established using site walk-downs (including discussions with the Operations & Maintenance staff), equipment databases, and plant drawings. A similar estimate was developed for dismantling systems and structures common to all units on site.

This cost estimate was prepared by applying unit cost factors (developed for each inventory item from prior dismantling experience or similar related experience) against the station specific inventory. Costs for project management, shared equipment and consumables, and similar types of costs are estimated on a period-dependent basis (i.e., the magnitude of the expense depends, in part, on the duration of the project and the types of activities taking place). While equipment salvage is not included, the potential value of scrap from materials generated in dismantling the boilers, plant components, and building structural steel is included as a credit in the dismantling cost estimate. Contingency is provided within this estimate to account for unpredictable project events.

This estimate includes the costs to remove all structures on the site to a nominal level of three feet below grade. Concerns for worker safety reinforce the need for a controlled approach. The cost estimates reflect demolition by controlled/engineered dismantling.

Limited site landscaping includes grading and seeding for drainage and erosion control.

Section 2 of this report identifies the activities and sequence of activities necessary to dismantle a generating station. Section 3 provides the specific bases for the estimate. Section 4 discusses scrap metal and associated credits to the dismantling costs. Section 5 provides the results. Appendices, noted throughout this report, provide additional information important to understanding this estimate.

# 2. DISMANTLING OPERATIONS

The estimate for dismantling the stations is based on the complete removal of the units and common station facilities (except where noted). The following sections describe the project organization, basic activities, and special equipment necessary for accomplishing the dismantling project.

## 2.1 PROJECT ORGANIZATION

For the purposes of this study, the dismantling project for each station is assumed to be managed by a Westar Project Director, who would have the primary responsibility for dismantling the station. A Dismantling Contractor, experienced in dismantling similar facilities, would be hired as the prime contractor for the removal of plant components and site facilities. The Dismantling Contractor's Project Manager would report to the Project Director. The Dismantling Contractor would manage and supervise the dismantling activities of the station and be responsible for completing the work in an expeditious and safe manner. Contractor personnel would manage and direct the labor force in accordance with approved procedures and in accordance with a health and safety program. The owner's staff would maintain and/or provide the engineering, safety, and environmental compliance oversight, and the security services necessary to support dismantling operations. Figures 2.1 and 2.2 identify typical organizations for the plant/utility staff and the associated contractor personnel during the dismantling phase of the project. The smaller facilities included within this estimate would have a commensurately smaller project organization (Abilene, Hutchinson, and Tecumseh).

## 2.2 POST-SHUTDOWN ACTIVITIES

The estimate is based on each station being shut down and placed into a post-shutdown configuration by the plant staff. The length of time that the facility is in this configuration is indeterminate, consequently the costs for maintaining the facility in this configuration is not included within the scope of this dismantling estimate. The activities to be completed post-shutdown, but prior to station dismantling, include:

- Removal of consumables and supplies not needed in the post-shutdown configuration
- Removal of residual fuels (including fuel oil)
- Removal of acids and caustics; flushing and cleaning of storage tanks

- Cleaning of equipment, e.g., filters and holding tanks
- Removal of hazardous waste and combustible materials
- If the unit is to be maintained in a condition where lighting, electricity, heating, water, sanitary, and similar services are to remain active, reconfigure these systems to minimize maintenance requirements
- Disposition of surplus bulk chemicals and gas storage containers
- Completion of a hazardous materials survey of the station
- Installation of any appropriate physical barriers (sealing circulating water system) and/or security barriers
- Maintenance of the facility (maintaining roofs and windows, drain systems, and electrical systems to preclude creating hazardous working conditions in the future)

Except for the hazardous materials survey, costs to conduct these activities have not been included in this estimate. The plant operations and maintenance staff would be expected to perform these activities in the interval of time between final plant shutdown, and the onset of the dismantling program.

## 2.3 DISMANTLING PROGRAM

The actual dismantling program begins once the station owner has decided to dismantle the site, either immediately following final shutdown, or after a period of storage following final shutdown. The dismantling program has been organized into three distinct periods: Period 1 - Engineering/Planning and Asbestos and Other Hazardous Material Abatement (if necessary); Period 2 - Dismantling Operations; and Period 3 - Site Restoration. This section summarizes the activities performed under each Period of the program.

For the purposes of this estimate it is assumed that once the decision to dismantle has been made and a project start date established, the work in each of these periods will be completed successively (no delay between periods). This report does not attempt to describe all of the activities necessary to dismantle a station, but identifies representative activities appropriate to this type of project.

2.3.1 Period 1- Engineering/Planning and Asbestos Abatement

**Engineering/Planning:**

A preliminary planning phase of the program begins once it is has been determined that a station will be dismantled and the project has been authorized to proceed. During this phase, the owner assembles its dismantling management organization, makes appropriate decisions regarding the extent of dismantling and the approach to managing the activities, and accomplishes those site preparation activities necessary to transition from a plant shutdown configuration to site dismantling. For purposes of this estimate it is assumed that the intent is to dismantle the entire station as a single project. Costs incurred during this preliminary phase of the program are included in the dismantling costs presented in this study.

The Owner prepares the stations for dismantling by performing the following activities:

- Prepare specifications that identify and describe the objectives and major work activities to be accomplished (establishing the final site configuration)
- Assemble plant documentation that may be relevant to dismantling (drawings, hazardous material reports, environmental studies, etc.)
- Select an asbestos abatement contractor (if required) and Dismantling Contractor
- Assemble and mobilize the management and oversight team responsible for the project

**Asbestos Abatement (if applicable)**

The asbestos abatement contractor prepares for this work by thoroughly understanding the scope of the asbestos remediation work and obtaining the permits necessary to initiate the work. Abatement of asbestos is considered an important prerequisite to dismantling the station's systems and structures. The method by which asbestos is abated is strictly controlled by federal and/or state regulations and includes the following requirements:

- Work will be done inside enclosures designed to capture any asbestos-containing particles. With the exception of removal of small quantities of asbestos in local areas, it would be expected that most work will be done in large enclosures (containment tents). The enclosures will have a filtered exhaust and be maintained under negative air pressure (air will leak into the enclosure rather than leak out).

- The air outside of the enclosures will be monitored to ensure barriers are effective.
- Workers, while working inside enclosures, will wear respiratory protective equipment as well as protective clothing.
- All materials removed from the enclosure will be packaged in accordance with regulations (minimum double-bag), and will be removed via a materials handling access area.
- Workers will enter and exit the enclosures through a personnel decontamination chamber in a controlled manner (ensuring asbestos contamination does not spread beyond the containment).
- After the asbestos abatement is complete, the effectiveness of the process will be established via regulatory-specified processes (generally verifying that there is no asbestos containing material capable of becoming airborne).
- Asbestos containing materials will be disposed of at a properly licensed disposal facility.
- After ensuring that all asbestos has been removed, the enclosures will be taken down in accordance with regulatory requirements and disposed of at a licensed facility.

**Dismantling Preparations**

The dismantling contractor prepares the station for dismantling by performing the following activities:

- Installing environmental barriers and monitoring equipment
- Reviewing plant drawings and specifications that may be useful for the dismantling project
- Identifying the processes to achieve the final desired station configuration
- Identifying the major work sequence
- Preparing dismantling activity specifications and work orders/forms
- Preparing detailed dismantling procedures

- Preparing a dismantling plan
- Preparing permit application(s) for plant demolition
- Mobilizing site staff
- Configuring temporary services/facilities to support dismantling operations
- Arranging for heavy lift and dismantling equipment, rigging, and tooling
- Hiring the local labor force

2.3.2 Period 2 - Dismantling Operations

Dismantling activities are initiated after completing the engineering and planning process, and after asbestos abatement is complete. The sequence of activities will be determined at the time of dismantling, but typically a sequence would include the following items (not all activities will be required for each station, particularly those with Combustion Gas Turbines):

- Removing above-ground storage tanks
- Removing large equipment from rooftops or at higher elevations
- Removing equipment that must be removed prior to start of boiler structure removal, including air and flue gas ducts, etc.
- Removing the top of the boiler enclosure to allow access to the platens
- Removing the boiler waterwalls
- Removing steam drum and deaerator by severing all connections and lowering to grade
- Removing boiler structural steel
- Disassembling the turbine/generator and condenser
- Removing all other equipment and components required prior to structures demolition
- Removing the turbine building superstructure and interior floors
- Blasting/dismantling the concrete turbine-generator pedestal(s)
- Removing siding from buildings
- Dismantling steel framing

- Demolishing structural concrete
- Removing the stack(s)
- Removing cooling tower(s) and / or cooling water intake and discharge structures
- Removing all other site structures within the scope of the dismantling program
- Sorting and organizing materials for pickup by the scrap dealer(s)
- Size reducing concrete rubble to enhance its suitability for backfill
- Removing any temporary services used to support the dismantling effort (lighting / ventilation / electrical / groundwater management)

### 2.3.3 Period 3 - Site Restoration

Site restoration activities are initiated following completion of the dismantling operations. The objective of site restoration in this estimate is to restore the station grounds to a configuration that does not pose a safety hazard; and plant vegetation for erosion control. As such, landscaping will be limited to grading, placement of top soil, and seeding. Site restoration as used in this estimate is not intended to re-configure the station for redevelopment, e.g. use as a recreational or industrial facility.

A typical site restoration sequence would be:

- Backfill below grade voids with recycled concrete rubble (reinforcing steel removed from concrete) or with additional fill, if necessary
- General grading of the station
- Placement of top soil or other suitable surface material necessary to maintain erosion control
- Landscaping to the extent necessary to re-vegetate the station (grass or similar plant materials), and
- Demobilizing personnel and equipment

**FIGURE 2.1**
**DISMANTLING PROJECT ORGANIZATION**
**UTILITY STAFF**

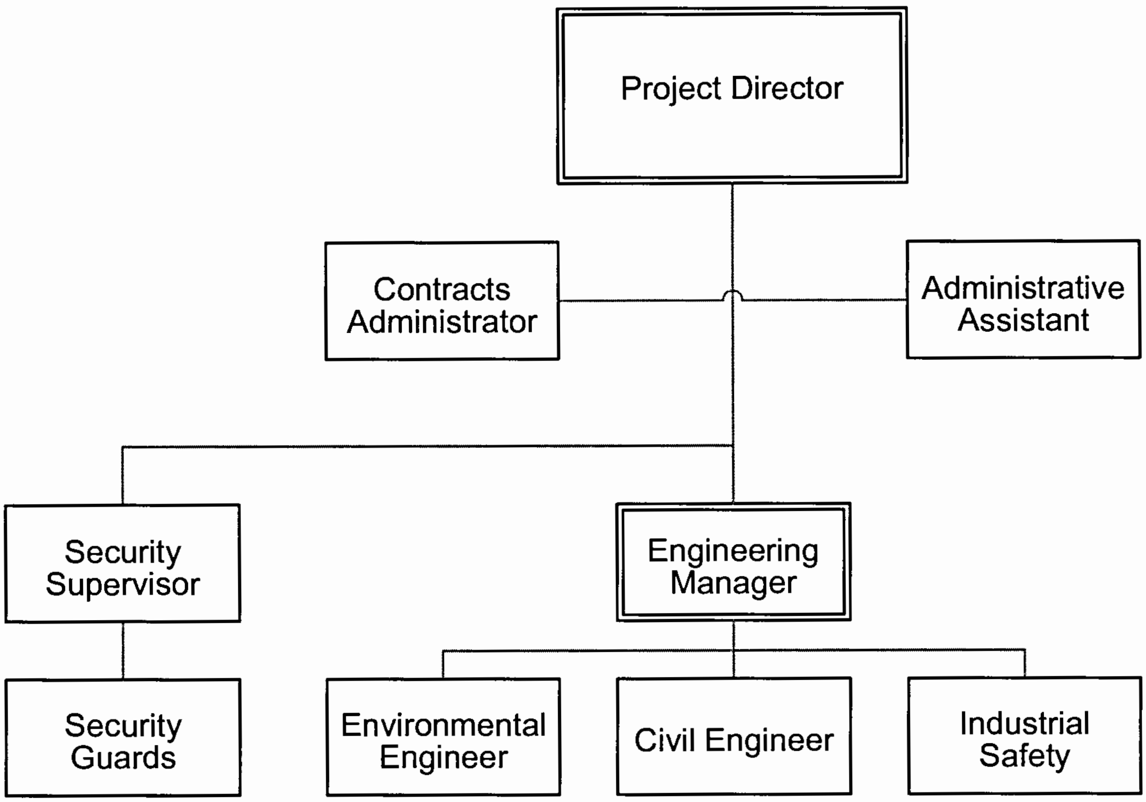
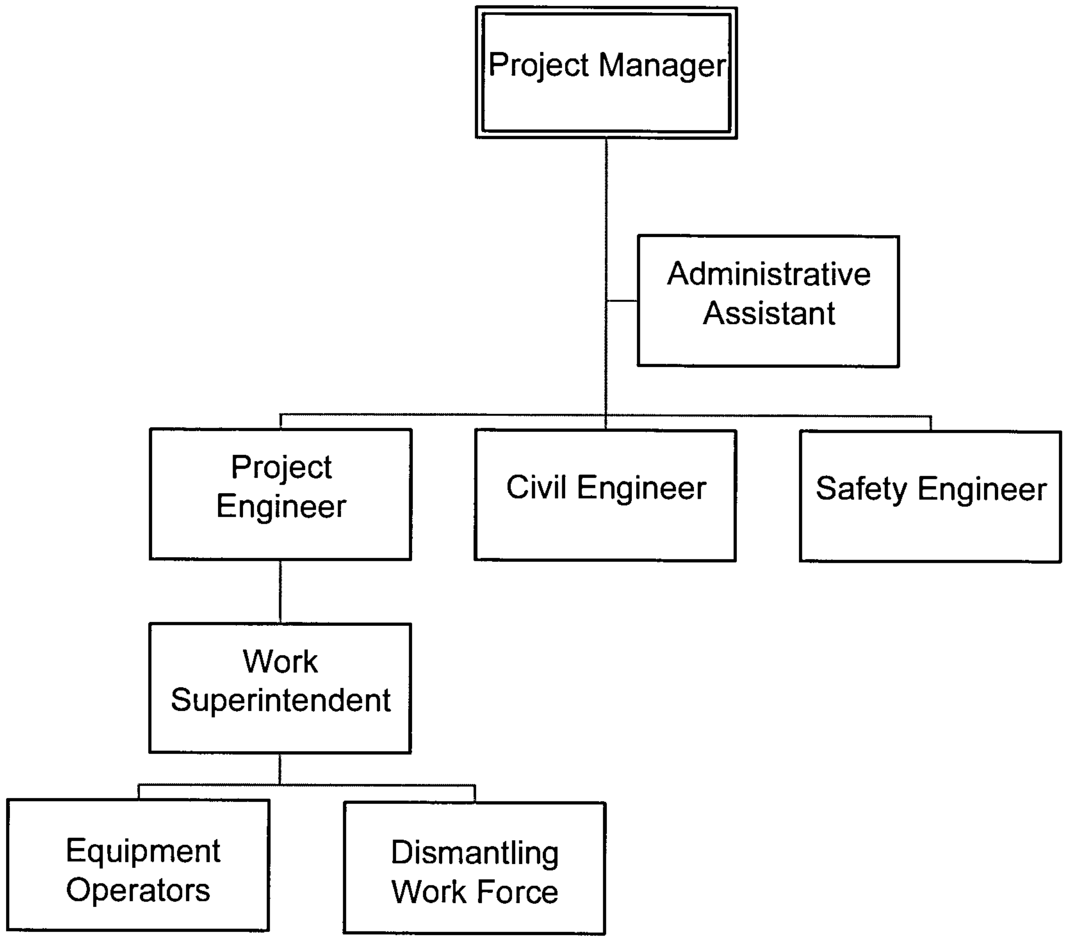


**FIGURE 2.2**
**DISMANTLING PROJECT ORGANIZATION**
**DISMANTLING CONTRACTOR STAFF**



# 3. COST ESTIMATE

The basis, methodology, and assumptions for the site-specific cost estimate are described in the following paragraphs.

## 3.1 BASIS OF ESTIMATE

Inventory of Materials to be Removed

The inventory is an essential element of the estimate, since dismantling costs are determined by applying unit cost factors against the corresponding inventory quantities. TLG developed the inventory by conducting a walk-down of the station, and extracting information from station-specific drawings and photos. The inventory used in developing the estimate for each station is provided in Appendix B.

Where TLG had previously developed inventory information for a boiler and turbine of similar size, fuel type and vintage, referred to as "reference unit", this information was used to represent the boiler / turbine systems inventory for the comparable Westar unit. The inventory was adjusted to reflect the difference between the rating of the Westar unit boiler / turbine and the rating of the reference unit; see Appendix A for further details.

There are expected differences in other facilities, even if the boiler and turbine are similar between comparable units. These include systems and structures associated with cooling water intake and discharge, fuel handling, exhaust gas, maintenance buildings and shops, pollution-control, and the quantity and extent of asbestos containing material (if applicable). For example, the reference plant inventory used for Neosho was based on a refractory lined steel chimney. Since the chimney at Neosho is concrete and has differing dimensions; field measurements of the chimney at Neosho were taken, and applied to the site-specific inventory. This new data replaced the reference plant data. For these systems and structures

Economic Cost Drivers

In developing an estimate, the cost of labor, equipment and material, credit for scrap, and similar costs will influence the results of the estimate. The basis for the significant cost drivers are:

1. Craft labor rates are based on existing contracts with craft labor contractors. These rates were provided by Westar (Ref. 1).

2. Utility labor rates are based on current labor costs for positions likely to be employed during the dismantling project. These rates were provided by Westar (Ref. 2).
3. Material and equipment costs for conventional demolition and/or construction activities, Contractors Insurance, Small Tools Allowance, Permit / Fees, and Contractor's Fee are based on R.S. Means Construction Cost Data (Ref. 3).
4. Scrap metal prices are based on Recycler's World published indices (Ref. 4).
5. Contingency, contractor fee, contractor insurance, environmental sampling, and permits & fees are based upon R.S. Means Construction Cost Data.
6. Costs in this estimate are in 2011 dollars.
7. Property taxes (or payments in lieu of taxes) are not included within the estimate.
8. The estimate to dismantle the stations does not address credit associated with the residual value of the land.

## 3.2 METHODOLOGY

The methodology used to develop the cost estimate follows the basic approach presented in the AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates" (Ref. 5) and the US DOE "Decommissioning Handbook" (Ref. 6). These publications utilize a unit factor method for estimating decommissioning activity costs to simplify the estimating calculations. Unit cost factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/in) are developed from the labor cost information from R. S. Means. The activity-dependent costs are estimated using item quantities (cubic yards, tons, inches, etc.) developed from plant drawings and inventory documents. The unit factors used in this study reflect the latest available information on worker productivity in plant dismantling. A sample unit cost factor is provided in Appendix C. A list of unit cost factors is provided in Appendix D.

An activity duration critical path is developed to determine the total dismantling program schedule. This program schedule is then used to determine the period-dependent costs for program management, administration, field engineering, equipment rental, quality assurance, and security. TLG estimated typical salary and hourly rates for personnel associated with period-dependent costs. The costs for conventional demolition of structures, materials, backfill, landscaping, and equipment rental are obtained from R.S. Means. Examples of such unit factor development are presented in AIF/NESP-036.

The unit cost factor method provides a demonstrable basis for establishing reliable cost estimates. The detail of activities for labor costs, equipment and consumables costs provide assurance that cost elements have not been omitted. Detailed unit cost factors, coupled with the site-specific inventory of piping, components and structures provide confidence in the cost estimates.

The activity-dependent and period-dependent costs are combined with applicable collateral costs to yield the direct decommissioning cost. A contingency is then applied. "Contingencies" are defined in the Association for the Advancement of Cost Engineering "Project and Cost Engineers' Handbook" (Ref. 7) as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this estimate are based on ideal conditions; therefore, a contingency factor has been applied.

Examples of items that could occur but have not otherwise been accounted for in this estimate include: labor work stoppages, bad weather delays, equipment/tool breakage, changes in the anticipated plant shutdown conditions, etc. These types of unforeseeable events are discussed in the AIF/NESP-036 study. Guidelines are also provided for applying contingency.

## 3.3 ASSUMPTIONS

The following assumptions were used in developing the dismantling estimate.

Pre-requisite Activities

1. Dismantling of the station will not commence until all units are retired (cost estimate is not based on independent dismantling of units while adjacent units are operating).
2. The arrangements of the unit facilities as they exist in 2011 based upon walk-downs conducted by TLG, and databases and drawings for similar units in TLG's database.
3. The dismantling process will be an engineered process with substantial consideration for industrial (worker) safety.

4. The demolition will be performed by a Dismantling Contractor who is responsible to provide adequate staff and equipment to complete the dismantling in a safe manner.
5. Site security costs to restrict access to the demolition project by unauthorized personnel are included.
6. On-site fuel inventories will be used and/or removed prior to start of dismantling.
7. Tanks will be emptied by operations and maintenance staff after shutdown.
8. Acids, caustics, and similar hazardous materials will be removed by operations and maintenance staff after shutdown.
9. Consumables, such as ion exchange materials and filters, will also be removed by operations and maintenance staff after shutdown.
10. Stores, spare parts, gas storage containers, laboratory equipment, office furniture, etc., will be removed by the owner after shutdown.
11. Oils used in station transformers are PCB-free. Lubricating and transformer oils are drained and removed by operations and maintenance staff after shutdown.
12. Asbestos (if present) will be removed prior to the start of dismantling. Asbestos insulation and PACM (presumed asbestos containing materials) will be disposed of at licensed facilities. Quantities of asbestos are based on owner-provided information where available. Where such information was not available, the quantities of asbestos were estimated.
13. Prior to initiating dismantling, essentially all live circuits will have been de-energized (to preclude creating an industrial hazard). If required, temporary services systems (air, water, electrical, fire water, etc.) will be used to support dismantling operations and will remain in service throughout the project until no longer required.

<u>Economic Assumptions</u>

14. Post-shutdown "dormancy" costs (i.e., security and maintenance on any of the units retired prematurely) are not included in the study.
15. Escalation/inflation of the costs over the remaining operating life is not included.
16. A 12.5% fee is added to the Demolition Contractor's cost to account for its overhead and profit.

17. A 25% contingency is applied to asbestos remediation activities.

18. A 15% contingency is applied to all remaining dismantling-related costs.

19. An allowance has been included for post-dismantling environmental monitoring costs.

20. A credit for scrap metal cost recovery is included in the estimates. Retired plant equipment is assumed to have no value as salvage (sold for re-use).

Physical Work Assumptions

21. The costs for disposition (if required) of contaminated soil (e.g., PCBs, hydrocarbons, lead, asbestos, mercury, acids or caustics) are outside the scope of this estimate.

22. Large equipment, components, and commodities (piping, cable, conduit, etc.) will be removed prior to structures demolition.

23. An environmental hazards crew will be maintained throughout the demolition period to address such items as lead paint and asbestos that was inaccessible during the asbestos remediation period (where applicable).

24. Turbine pedestals and powerhouse building foundations will be removed by controlled blasting and back-filled to grade.

25. Structures and foundations will be removed to a depth of three feet below grade, with any resulting voids back-filled to grade level.

26. Chimney stacks will be blasted to the ground and broken into rubble, the steel liners cut and removed, and the foundations control-blasted to break the concrete in place so that groundwater drainage is provided.

27. The dismantling of the electrical equipment terminates at the switch yard boundary. The switch yard is left intact.

28. Concrete rubble generated during dismantling will be used as fill where needed.

29. The site will be graded; however, no effort was included in this estimate to restore the original contour of the land. Ground cover will be established for erosion control.

30. Roads, parking lots, etc., are removed after the facility is dismantled (with the exception of the immediate area around the switchyard).

Scheduling Assumptions

31. All work is performed during an eight-hour workday, five days per week, with no overtime.
32. Multiple crews work parallel activities to the maximum extent possible, consistent with efficiency (adequate access for cutting, removal, and laydown space) and with industrial safety appropriate for demolition of heavy components and structures.
33. Scheduling was calculated without constraints on availability of labor, equipment, or materials.

## 3.4 UNIT-SPECIFIC NOTES

### 3.4.1 Abilene CT 1

A complete inventory of system components and concrete structures was obtained from the site walk down by TLG.

### 3.4.2 Hutchinson CT 4

This unit was determined to be identical with Abilene Unit 1, except for certain features obtained from the site walk down by TLG.

### 3.4.3 Murray Gill Units 1 & 2

The power-block systems and structures inventories for Units 1 & 2 were taken from the TLG data base of units with similar generating capacity and fuel type. The inventory of non-power block systems and structures was developed from information recorded during the site walk down.

### 3.4.4 Neosho Unit 3

The power-block systems and structures inventory for Unit 3 was taken from the TLG data base of units with similar generating capacity and fuel type. The inventory of non-power block systems and structures was developed from information recorded during the site walk down.

### 3.4.5 Tecumseh CT 1 & 2

A complete inventory of system components and concrete structures was obtained from the site walk down by TLG.

# 4. SCRAP METAL CREDITS

The dismantling of a fossil plant typically occurs after a lengthy plant operating life. The existing installed plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. Dismantling techniques assumed by TLG for equipment in this analysis are not consistent with removal techniques required for salvage (resale) of equipment. Experience has indicated that buyers prefer equipment stripped down to very specific requirements before they would consider purchase. This can require expensive work to remove the equipment from its installed location, which is inconsistent with the rapid dismantling approach assumed in this estimate. Since placing any salvage value on this machinery and equipment would be speculative, and the value would expected to be small in comparison to the overall cost of dismantling, this study does not attempt to quantify the value that an owner may realize from salvaging installed plant equipment.

Furniture, tools, mobile equipment such as forklifts, trucks, bulldozers, and other property is removed at no cost or credit to the dismantling project. Disposition may include relocation to other Westar facilities. Spare parts are assumed to be made available for alternative use within the Westar system.

The materials used in the equipment and buildings are however expected to be suitable for recycle as scrap metals. As such, an estimated value of the scrap metal credit has been developed and applied to each station's cost estimate. The value of scrap was estimated using current market values extracted from published sources and applying this value to the estimated quantities of materials generated from the dismantling project. There were four basic types of metals used in the scrap estimates; carbon steel (the most common material used at the station), copper, stainless steel (high alloy steel) and aluminum. The scrap credit, in addition to considering the quantity and types of materials, also considered the cost of handling and transporting these materials to a major scrap processing location (Houston, TX area) where scrap is extensively used or sold. The value of the scrap credit is reduced to account for transportation costs from Kansas to Texas.

The basis for the value of scrap metal is summarized in Table 4.1. A summary of the scrap quantities, by material type, produced from dismantling each unit is provided in Table 4.2. An estimate of the total scrap credit, after the scrap quantities have been applied against the scrap metal prices, is provided in Table 4.3.

# TABLE 4.1
# BASIS FOR SCRAP METAL VALUE
(2011 Dollars)

| Type of Material | Scrap Category [1] | Market Value [2] | Units | Transport Cost [3] | Scrap Metal Credit [4] (per ton) |
|---|---|---|---|---|---|
| Carbon Steel | Cast Iron | 269.67 | Per Ton | 72.56 | 197.11 |
| | No. 1 | 337.09 | Per Ton | 72.56 | 264.52 |
| | Mixed Scrap | 269.67 | Per Ton | 72.56 | 197.11 |
| | Galvanized | 67.42 | Per Ton | 72.56 | 0.00 |
| Stainless Steel | SS-1 | 1.20 | Per Pound | 0.04 | 2,333.74 |
| Copper | Insulated Cable | 1.85 | Per Pound | 0.04 | 3,618.94 |
| | No. 2 Copper | 2.95 | Per Pound | 0.04 | 5,834.23 |
| | Copper-Nickel | 6.40 | Per Pound | 0.04 | 12,733.74 |
| | Large Motor | 0.44 | Per Pound | 0.04 | 812.86 |

Note 1: Scrap categories are consistent with information provided in Recycler's World

Note 2: The market value for scrap metal used in this estimate is based on Recycler's World U.S. Scrap Metal Index Historical Market Price. Values shown represent the average over a 12 month period from April 1, 2010 to March 31, 2011.

Note 3: The estimated cost for handling and transporting the materials to a major scrap processing center in the Houston, TX area is $72.27 / ton or $0.036 / pound.

Note 4: The scrap metal credit reflects the market value of scrap adjusted for handling and transport cost to local scrap metal recycler.

**TABLE 4.2**
**QUANTITY OF SCRAP METALS**
(pounds)

| Name | Carbon Steel | | | Stainless Steel | | Copper | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cast Iron | No. 1 | Mixed Scrap | SS-1 | Galvanized Steel | Insul Cbl | No. 2 Cu | Large Mtr | Copper Nickel | Total |
| Abilene CT 1 | 14,515 | 265,173 | 896,533 | 2,798 | 10,000 | - | 93,574 | 169,298 | - | 1,451,890 |
| Hutchinson CT 4 | 26,241 | 359,253 | 912,852 | 2,514 | 10,000 | - | 99,013 | 169,298 | - | 1,579,172 |
| Murray Gill Units 1 & | 1,091,368 | 8,279,126 | 16,042,940 | 255,830 | 268,137 | 116,406 | 111,266 | 874,057 | 223,349 | 27,262,481 |
| Neosho Unit 3 | 598,711 | 6,677,996 | 12,164,347 | 138,844 | 112,794 | 63,744 | 63,384 | 433,452 | 144,303 | 20,397,575 |
| Tecumseh CT 1 &#2 | 17,154 | 806,800 | 899,846 | 5,274 | 10,000 | - | 92,963 | 92,398 | - | 1,924,434 |
| **Total** | **1,747,988** | **16,388,348** | **30,916,518** | **405,261** | **410,932** | **180,150** | **460,200** | **1,738,503** | **367,653** | **52,615,552** |

**TABLE 4.3**
**SCRAP METAL CREDITS**
(thousands of 2011 dollars)

| Name | Carbon Steel: Cast Iron | Carbon Steel: No. 1 | Carbon Steel: Mixed Scrap | Stainless Steel: SS-1 | Galvanized Steel | Copper: Insul Cbl | Copper: No. 2 Cu | Copper: Large Mtr | Copper Nickel | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Abilene CT 1 | $ 1 | $ 35 | $ 88 | $ 3 | $ 0 | $ - | $ 273 | $ 69 | $ - | $ 470 |
| Hutchinson CT 4 | $ 3 | $ 48 | $ 90 | $ 3 | $ 0 | $ - | $ 289 | $ 69 | $ - | $ 501 |
| Murray Gill Units 1 & | $ 108 | $ 1,095 | $ 1,581 | $ 299 | $ 0 | $ 211 | $ 325 | $ 355 | $ 1,422 | $ 5,395 |
| Neosho Unit 3 | $ 59 | $ 883 | $ 1,199 | $ 162 | $ 0 | $ 115 | $ 185 | $ 176 | $ 919 | $ 3,698 |
| Tecumseh CT 1 & 2 | $ 2 | $ 107 | $ 89 | $ 6 | $ 0 | $ - | $ 271 | $ 38 | $ - | $ 512 |
| **Total** | **$ 172** | **$ 2,168** | **$ 3,047** | **$ 473** | **$ 0** | **$ 326** | **$ 1,342** | **$ 707** | **$ 2,341** | **$ 10,575** |

# 5. RESULTS

An estimate for dismantling certain of the Westar fossil-fuel generating stations in Kansas was developed by applying the system and structures inventories against the associated unit cost factors and accounting for program support costs. A summary of each station's major cost categories is presented in Table 5.1. Breakdowns of the major cost categories by unit and common facilities are provided in Tables 5.2a through e.

The following is an explanation of the contents of each line item in these tables:

*Station Unit Rating (MWe)* – This is the nominal electrical rating of each unit at the station. In Table 5.1 this represents the sum of all units on site.

*Demolition Preparations / Temporary Services* – The cost associated with ensuring that all energized systems have been isolated from the buildings scheduled for dismantling and the cost for installing temporary services to support the dismantling.

*Scaffolding / Worker Access* – The cost associated with providing safe access to areas of the station being dismantled.

*Asbestos Remediation* – The cost associated with remediating asbestos from the station prior to initiating dismantling activities. It should be noted that dismantling can proceed much more efficiently if asbestos containing materials have been removed.

*Equipment Removal* – The cost associated with removing all station equipment (piping, valves, heat exchangers, tanks, electrical equipment, etc.).

*Boiler(s)* – The cost associated with removing the boiler.

*Structures Demolition* – The cost associated with demolishing the buildings and concrete foundations (to three feet below grade.

*Backfill / Grade / Landscaping* – The cost associated with backfilling below grade voids, and grading and landscaping the grounds to preclude erosion of soils.

*Ongoing Environmental Monitoring (quarterly for 5 years)* – The cost associated with monitoring the environment around the station after the completion of dismantling activities.

*Utility Management / Oversight* – The staff directly assigned to manage the dismantling project, including planning, execution, oversight, and restoration.

*Demolition Contractor Staff* – The contractor's staff assigned to manage, engineer, and supervise the dismantling project.

*Security* – Personnel assigned to control access to the dismantling site.

*Property Taxes* – Not included in this estimate.

*Shared Heavy Equipment / Operating Engineers* – The cost for renting / operating equipment in general use throughout the dismantling project (cranes, trucks, forklifts, front-end loaders, etc.).

*Small Tool Allowance* – The cost for procuring small tools.

*Utilities Allowance (Office Equip & supplies / Telephone, Electric etc.)* – The cost for procuring utility services and office supplies.

*Permits* – The cost of obtaining permits.

*Demolition Contractors Insurance* – The cost of the demolition contractors insurance.

*Demolition Contractors Fee* – A fee applied to contractor activities.

*Contingency* – The cost to cover expenses for unforeseen events that are likely to occur.

*Scrap Credit* – A credit to the project for the recovery of scrap metals.

*Unit (Table 5.2)* – Costs directly attributed to the physical work associated with dismantling a generating unit.

*Common (Table 5.2)* – Costs directly attributed to the physical work associated with dismantling facilities shared by more than one unit.

*Station (Tables 5.2)* – Costs associated with supporting the physical dismantling work for each station. Note that the costs stated are limited to the work scope identified by Westar for each site.

This study provides an estimate for dismantling under current requirements, based on present-day costs and available technology. As inputs to the cost model change over time, such as labor rates, equipment costs, scrap metal value, etc., this cost estimate should be reviewed and updated to reflect these changes.

**TABLE 5.1**
**SUMMARY OF ACTIVITY COSTS**
(2011 Dollars)

| Activities (Costs) | Abilene CT 1 | Hutchinson CT 4 | Murray Gill Units 1 & 2 | Neosho Unit 3 | Tecumseh CT 1 & 2 | Fleet Totals |
|---|---|---|---|---|---|---|
| Station Rating (MWe) | 77 | 86 | 114 | 66 | 58 | 401 |
| Characterization / Temporary Services | 90,423 | 91,423 | 419,385 | 211,693 | 79,423 | 892,348 |
| Worker Access | - | - | 212,302 | 110,678 | - | 322,980 |
| Asbestos Remediation | - | - | 1,809,603 | 1,184,307 | - | 2,993,910 |
| Equipment Removal | 157,337 | 165,206 | 1,794,027 | 1,672,706 | 300,247 | 4,089,523 |
| Boiler(s) | - | - | 1,065,255 | 742,153 | - | 1,807,408 |
| Structures Demolition | 109,002 | 131,555 | 1,434,739 | 980,313 | 173,668 | 2,829,277 |
| Backfill / Grade / Landscaping | 37,986 | 43,176 | 446,458 | 229,673 | 62,778 | 820,071 |
| Ongoing environ. monitoring (quarterly for 5 years) | 38,000 | 38,000 | 250,000 | 241,000 | 38,000 | 605,000 |
| Utility Management / Oversight | 102,096 | 109,659 | 1,204,112 | 694,206 | 105,577 | 2,215,650 |
| Demolition Contractor Mgmt / Super. / Safety Staff | 108,802 | 118,487 | 1,567,395 | 1,026,461 | 88,957 | 2,910,102 |
| Security | 59,142 | 63,578 | 334,153 | 335,632 | 62,099 | 854,605 |
| Property Taxes | 0 | 0 | 0 | 0 | 0 | 0 |
| **Project Expenses** | | | | | | |
| Shared Heavy Equipment / Operating Engineers | 179,915 | 196,404 | 1,674,781 | 1,047,623 | 143,453 | 3,242,176 |
| Small Tool Allowance | 4,417 | 4,874 | 85,630 | 62,073 | 7,184 | 164,177 |
| Utilities Allowance | 6,924 | 7,444 | 39,123 | 39,296 | 7,271 | 100,059 |
| Permits | 9,160 | 9,957 | 134,984 | 94,350 | 11,262 | 259,713 |
| Demolition Contractors Insurance | 21,554 | 23,430 | 317,623 | 222,010 | 26,501 | 611,117 |
| Demolition Contractors Fee | 77,090 | 84,184 | 1,179,239 | 824,609 | 101,473 | 2,266,595 |
| Sub-Total | 1,001,848 | 1,087,377 | 13,968,809 | 9,718,781 | 1,207,892 | 26,984,708 |
| Contingency | 150,277 | 163,107 | 2,276,282 | 1,576,248 | 181,184 | 4,347,097 |
| Project Total (before scrap credit) | 1,152,125 | 1,250,484 | 16,245,091 | 11,295,029 | 1,389,076 | 31,331,806 |
| Scrap Credit | (469,898) | (500,642) | (5,394,679) | (3,698,278) | (511,974) | (10,575,471) |
| Project Total | 682,227 | 749,842 | 10,850,412 | 7,596,751 | 877,102 | 20,756,335 |

**TABLE 5.2a**
**ABILENE COMBUSTION TURBINE 1**
**SUMMARY OF ACTIVITY COSTS**
(2011 Dollars)

| *Activities* | *Unit 1* | *Station* | *Station Total* |
|---|---|---|---|
| Abilene Unit Rating (MWe) | 77 | | |
| Characterization / Temporary Services | 49,000 | 41,423 | 90,423 |
| Worker Access | - | | 0 |
| Asbestos Remediation | - | | 0 |
| Equipment Removal | 157,337 | | 157,337 |
| Boiler(s) | - | | 0 |
| Structures Demolition | 109,002 | | 109,002 |
| Backfill / Grade / Landscaping | 37,986 | - | 37,986 |
| Ongoing environmental monitoring (quarterly for 5 years) | | 38,000 | 38,000 |
| Utility Management / Oversight | | 102,096 | 102,096 |
| Demolition Contractor Management / Supervisory / Safety Staff | | 108,802 | 108,802 |
| Security | | 59,142 | 59,142 |
| Property Taxes | - | - | 0 |
| **Project Expenses** | | | |
| Shared Heavy Equipment / Operating Engineers | | 179,915 | 179,915 |
| Small Tool Allowance | 4,417 | n/a | 4,417 |
| Utilities Allowance (Office Equip & supplies / Telephone, Electric etc.) | | 6,924 | 6,924 |
| Permits | | 9,160 | 9,160 |
| Demolition Contractors Insurance | | 21,554 | 21,554 |
| Demolition Contractors Fee | | 77,090 | 77,090 |
| Sub-Total | | | 1,001,848 |
| Contingency | | | 150,277 |
| Project Total (before scrap credit) | | | 1,152,125 |
| Scrap Credit | (469,898) | - | (469,898) |
| Project Total | | | 682,227 |

**TABLE 5.2b**

**HUTCHINSON COMBUSTION TURBINE 4**
**SUMMARY OF ACTIVITY COSTS**
(2011 Dollars)

| Activities | Unit 4 | Station | Station Total |
|---|---|---|---|
| Hutchinson Unit Rating (MWe) | 86 | | |
| Characterization / Temporary Services | 50,000 | 41,423 | 91,423 |
| Worker Access | - | | 0 |
| Asbestos Remediation | - | | 0 |
| Equipment Removal | 165,206 | | 165,206 |
| Boiler(s) | - | | 0 |
| Structures Demolition | 131,555 | | 131,555 |
| Backfill / Grade / Landscaping | 43,176 | - | 43,176 |
| Ongoing environmental monitoring (quarterly for 5 years) | | 38,000 | 38,000 |
| Utility Management / Oversight | | 109,659 | 109,659 |
| Demolition Contractor Management / Supervisory / Safety Staff | | 118,487 | 118,487 |
| Security | | 63,578 | 63,578 |
| Property Taxes | - | - | 0 |
| **Project Expenses** | | | |
| Shared Heavy Equipment / Operating Engineers | | 196,404 | 196,404 |
| Small Tool Allowance | 4,874 | n/a | 4,874 |
| Utilities Allowance (Office Equip & supplies / Telephone, Electric etc.) | | 7,444 | 7,444 |
| Permits | | 9,957 | 9,957 |
| Demolition Contractors Insurance | | 23,430 | 23,430 |
| Demolition Contractors Fee | | 84,184 | 84,184 |
| Sub-Total | | | 1,087,377 |
| Contingency (excluding activities currently under contract) | | | 163,107 |
| Project Total (before scrap credit) | | | 1,250,484 |
| Scrap Credit | (500,642) | - | (500,642) |
| Project Total | | | 749,842 |

# TABLE 5.2c
# MURRAY GILL UNITS 1 & 2
# SUMMARY OF ACTIVITY COSTS
(2011 Dollars)

| *Activities* | *Unit 1* | *Unit 2* | *Common* | *Station* | *Station Total* |
|---|---|---|---|---|---|
| Murray Gill Unit Rating (MWe) | 48 | 66 | 114 | | |
| Characterization / Temporary Services | 42,000 | 46,000 | - | 331,385 | 419,385 |
| Worker Access | 101,623 | 110,678 | - | | 212,302 |
| Asbestos Remediation | 631,995 | 1,177,608 | - | | 1,809,603 |
| Equipment Removal | 674,698 | 1,054,356 | 64,973 | | 1,794,027 |
| Boiler(s) | 323,102 | 742,153 | - | | 1,065,255 |
| Structures Demolition | 458,333 | 797,480 | 178,926 | | 1,434,739 |
| Backfill / Grade / Landscaping | 141,025 | 192,715 | 112,719 | - | 446,458 |
| Ongoing environmental monitoring (quarterly for 5 years) | | | | 250,000 | 250,000 |
| Utility Management / Oversight | | | | 1,204,112 | 1,204,112 |
| Demolition Contractor Management / Supervisory / Safety Staff | | | | 1,567,395 | 1,567,395 |
| Security | | | | 334,153 | 334,153 |
| Property Taxes | - | - | - | - | 0 |
| **Project Expenses** | | | | | |
| Shared Heavy Equipment / Operating Engineers | | | | 1,674,781 | 1,674,781 |
| Small Tool Allowance | 29,660 | 51,512 | 4,458 | n/a | 85,630 |
| Utilities Allowance (Office Equip & supplies / Telephone, Electric etc.) | | | | 39,123 | 39,123 |
| Permits | | | | 134,984 | 134,984 |
| Demolition Contractors Insurance | | | | 317,623 | 317,623 |
| Demolition Contractors Fee | | | | 1,179,239 | 1,179,239 |
| Sub-Total | | | | | 13,968,809 |
| Contingency | | | | | 2,276,282 |
| Project Total (before scrap credit) | | | | | 16,245,091 |
| Scrap Credit | (1,808,604) | (3,421,211) | (164,864) | - | (5,394,679) |
| Project Total | | | | | 10,850,412 |

## TABLE 5.2d

## NEOSHO UNIT 3
## SUMMARY OF ACTIVITY COSTS
(2011 Dollars)

| *Activities* | *Unit 3* | *Common* | *Station* | *Station Total* |
|---|---|---|---|---|
| Neosho Unit Rating (MWe) | 66 | 66 | | |
| Characterization / Temporary Services | 46,000 | - | 165,693 | 211,693 |
| Worker Access | 110,678 | - | | 110,678 |
| Asbestos Remediation | 1,184,307 | - | | 1,184,307 |
| Equipment Removal | 1,132,777 | 539,929 | | 1,672,706 |
| Boiler(s) | 742,153 | - | | 742,153 |
| Structures Demolition | 797,480 | 182,833 | | 980,313 |
| Backfill / Grade / Landscaping | 116,976 | 112,697 | - | 229,673 |
| Ongoing environmental monitoring (quarterly for 5 years) | | | 241,000 | 241,000 |
| Utility Management / Oversight | | | 694,206 | 694,206 |
| Demolition Contractor Management / Supervisory / Safety Staff | | | 1,026,461 | 1,026,461 |
| Security | | | 335,632 | 335,632 |
| Property Taxes | - | - | - | 0 |
| **Project Expenses** | | | | |
| Shared Heavy Equipment / Operating Engineers | | | 1,047,623 | 1,047,623 |
| Small Tool Allowance | 51,630 | 10,443 | n/a | 62,073 |
| Utilities Allowance (Office Equip & supplies / Telephone, Electric etc.) | | | 39,296 | 39,296 |
| Permits | | | 94,350 | 94,350 |
| Demolition Contractors Insurance | | | 222,010 | 222,010 |
| Demolition Contractors Fee | | | 824,609 | 824,609 |
| Sub-Total | | | | 9,718,781 |
| Contingency | | | | 1,576,248 |
| Project Total (before scrap credit) | | | | 11,295,029 |
| Scrap Credit | (3,438,380) | (259,898) | - | (3,698,278) |
| Project Total | | | | 7,596,751 |

## TABLE 5.2e

## TECUMSEH COMBUSTION TURBINE 1 & 2
## SUMMARY OF ACTIVITY COSTS
(2011 Dollars)

| *Activities* | *Unit 1* | *Unit 2* | *Common* | *Station* | *Station Total* |
|---|---|---|---|---|---|
| Tecumseh Unit Rating (MWe) | 29 | 29 | 58 | | |
| Characterization / Temporary Services | 38,000 | | - | 41,423 | 79,423 |
| Worker Access | - | - | - | | 0 |
| Asbestos Remediation | - | - | - | | 0 |
| Equipment Removal | 71,125 | 74,586 | 154,536 | | 300,247 |
| Boiler(s) | - | - | - | | 0 |
| Structures Demolition | 74,103 | 74,103 | 25,462 | | 173,668 |
| Backfill / Grade / Landscaping | 7,466 | 7,466 | 47,846 | - | 62,778 |
| Activities currently under contract | | | | 0 | 0 |
| Ongoing environmental monitoring (quarterly for 5 years) | | | | 38,000 | 38,000 |
| Utility Management / Oversight | | | | 105,577 | 105,577 |
| Demolition Contractor Management / Supervisory / Safety Staff | | | | 88,957 | 88,957 |
| Security | | | | 62,099 | 62,099 |
| Property Taxes | - | - | - | - | 0 |
| **Project Expenses** | | | | | |
| Shared Heavy Equipment / Operating Engineers | | | | 143,453 | 143,453 |
| Small Tool Allowance | 2,384 | 1,952 | 2,848 | n/a | 7,184 |
| Utilities Allowance (Office Equip & supplies / Telephone, Electric etc.) | | | | 7,271 | 7,271 |
| Permits | | | | 11,262 | 11,262 |
| Demolition Contractors Insurance | | | | 26,501 | 26,501 |
| Demolition Contractors Fee | | | | 101,473 | 101,473 |
| Sub-Total | | | | | 1,207,892 |
| Contingency | | | | | 181,184 |
| Project Total (before scrap credit) | | | | | 1,389,076 |
| Scrap Credit | (221,786) | (222,208) | (67,980) | - | (511,974) |
| Project Total | | | | | 877,102 |

## 6. REFERENCES

1. E-mail dated May 18, 2011 from Andy Rietcheck, P.E. of Westar Energy to Ben Stochmal at TLG Services; subject "Special Construction Labor Rates".
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3. "Building Construction Cost Data 2011," Robert Snow Means Company, Inc., Kingston, Massachusetts.
4. Recycler's World, Iron and Steel Recycling Section and Scrap Copper Recycling Section, U.S. Scrap Metal Index, average over a 12 month period from April 1, 2010 to March 31, 2011.
5. T.S. LaGuardia et al., "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.
6. W.J. Manion and T.S. LaGuardia, "Decommissioning Handbook," U.S. Department of Energy, DOE/EV/10128-1, November 1980.
7. AACE International, Skills and Knowledge of Cost Engineering, 4th Edition, 1999.

# APPENDIX A

# ESTIMATING INVENTORIES FOR SIMILAR SIZE UNITS

# APPENDIX A

## ESTIMATING INVENTORIES FOR SIMILAR SIZE UNITS

In order to cost-effectively develop estimates TLG recognized that units of a similar size and fuel type share many common characteristics. For instance, plant systems (feedwater, steam, condensate, coal-handling, generating, lubricating oil, electrical power distribution, etc.) would be designed to serve the same functions, contain similar components, and be similar in size. Similarly, the structures necessary to support these systems, including boiler building, turbine building, intake and discharge structures, and fuel handling would be designed to serve the same functions and would also be similar in size. Site-specific inventories have been developed for similar units using a combination of drawings, site walk downs, and databases. These reference unit inventories were extrapolated to represent inventories of equipment and structures for similar Westar units. This approach is referred to by AACE International (The Association for the Advancement of Cost Estimating) as a "scale of operations method" (Ref. 7).

The basic approach to the extrapolation is the following:

$$Q_2 = Q_1 * (C_2/C_1)^x$$

$C_1$ = Rating of Representative Unit (MWe)
$C_2$ = Rating of Similar Unit (MWe)

$Q_1$ = Quantity of Material Representative Unit (by component)
$Q_2$ = Quantity of Material Similar Unit (by component)

$x$ = constant (0.65 for equipment, 0.5 for structures) (estimators judgment)

The basic concept is that a similar unit, with a rating 20% greater than a representative unit, does not have a 20% increase in inventory. Using the scale of operation method, the component would have a $(120\%/100\%)^{0.65}$ = 112.6%, or a 12.6% increase in size or quantity. Practically, this is interpreted to mean that a pipe carrying 20% more fluid (e.g. feedwater) would be approximately 12.6% larger in size.

For units that are essentially identical, but may have slight differences in electrical ratings due to local conditions (efficiency of units), the inventories are also considered identical.

# APPENDIX B

# SUMMARY OF STATION SYSTEM AND STRUCTURES INVENTORIES

**TABLE B**
**SUMMARY OF STATION SYSTEMS AND STRUCTURES INVENTORIES**

| Index | System/Structure Inventory Data Point | Abilene | Hutchinson | Murray Gill | Neosho | Tecumseh |
|---|---|---|---|---|---|---|
| 2 | Piping 0.25 to 2 inches diameter, linear foot | 574 | - | - | 14,065 | 630 |
| 3 | Piping >2 to 4 inches diameter, linear foot | 383 | 383 | 13,922 | 9,377 | 420 |
| 4 | Piping >4 to 8 inches diameter, linear foot | 255 | 255 | 9,281 | 6,251 | 280 |
| 5 | Piping >8 to 14 inches diameter, linear foot | - | 300 | 6,187 | 4,167 | - |
| 6 | Piping >14 to 20 inches diameter, linear foot | - | - | 2,311 | 1,211 | - |
| 7 | Piping >20 to 36 inches diameter, linear foot | - | - | 1,970 | 2,280 | - |
| 8 | Piping >36 inches diameter, linear foot | - | - | 364 | 124 | - |
| 9 | Valves <2 inches | 66 | 66 | 1,004 | 734 | 78 |
| 10 | Valves >2 to 4 inches | 44 | 44 | 669 | 489 | 52 |
| 11 | Valves >4 to 8 inches | 22 | 22 | 446 | 326 | 26 |
| 12 | Valves >8 to 14 inches | - | 11 | 223 | 163 | - |
| 13 | Valves >14 to 20 inches | - | - | 46 | 21 | - |
| 14 | Valves >20 to 36 inches | - | - | 37 | 31 | - |
| 15 | Valves >36 inches | - | - | 15 | 8 | - |
| 24 | Pipe hangers for small bore piping, each | 38 | 15 | 557 | 938 | 42 |
| 25 | Pipe hangers for large bore piping, each | 10 | 22 | 805 | 561 | 11 |
| 26 | Pump and motor set < 300 pounds | - | - | 40 | 21 | 11 |
| 27 | Pumps, 300-1000 pound pump | - | - | 6 | 2 | - |
| 28 | Pumps, >1000-10,000 pound pump | - | - | 8 | 4 | - |
| 29 | Pumps, >10,000 pound pump | - | - | 11 | 4 | - |
| 32 | Pump motors, 300-1000 pound pump | - | - | 13 | 2 | - |
| 33 | Pump motors, >1000-10,000 pound pump | - | - | 8 | 4 | 2 |
| 34 | Pump motors, >10,000 pound pump | 4 | 4 | 9 | 4 | 2 |
| 38 | Main turbine-generator (pounds per MW(e) input) | - | - | 2 | 1 | - |
| 39 | Heat exchanger <3000 pound | - | - | 19 | 13 | - |
| 40 | Heat exchanger >3000 pound | - | - | 17 | 10 | - |
| 41 | Feedwater heater/deaerator | - | - | 10 | 5 | - |
| 49 | Main condenser (pounds per MW(e) input) | - | - | 2 | 1 | - |
| 51 | Tanks, <300 gallons, filters, and ion exchangers | 3 | 3 | 8 | 2 | 10 |
| 52 | Tanks, 300-3000 gallons | 2 | 2 | 5 | 4 | - |
| 53 | Tanks, >3000 gallons, square foot surface | 376 | 752 | 8,724 | 55,825 | 20,615 |
| 54 | Electrical equipment, <300 pound | 16 | 16 | 385 | 239 | 112 |
| 55 | Electrical equipment, 300-1000 pound | 10 | 10 | 66 | 59 | 38 |
| 56 | Electrical equipment, 1000-10,000 pound | 12 | 12 | 43 | 15 | 10 |
| 57 | Electrical equipment, >10,000 pound | 6 | 6 | 16 | 8 | 4 |
| 59 | Electrical transformers < 30 tons | 1 | 1 | 2 | 2 | - |
| 60 | Electrical transformers > 30 tons | 2 | 2 | 2 | 1 | 4 |
| 64 | Fluorescent light fixture | - | - | 87 | 68 | - |
| 65 | Incandescent light fixture | - | - | 339 | 210 | - |

**TABLE B**
**SUMMARY OF SYSTEMS AND STRUCTURES INVENTORIES**
**(Continued)**

| Index | System/Structure Inventory Data Point | Abilene | Hutchinson | Murray Gill | Neosho | Tecumseh |
|---|---|---|---|---|---|---|
| 66 | Electrical cable tray, linear foot | - | - | 5,018 | 3,128 | - |
| 67 | Electrical conduit, linear foot | - | - | 24,874 | 12,874 | - |
| 69 | Mechanical equipment, <300 pound | 10 | 10 | 428 | 267 | - |
| 70 | Mechanical equipment, 300-1000 pound | 53 | 53 | 130 | 109 | 24 |
| 71 | Mechanical equipment, 1000-10,000 pound | 56 | 56 | 21 | 4 | 38 |
| 72 | Mechanical equipment, >10,000 pound | 9 | 9 | 1 | - | 8 |
| 76 | HVAC equipment, <300 pound | - | - | 6 | 1 | - |
| 78 | HVAC equipment, 1000-10,000 pound | - | - | 2 | - | - |
| 82 | HVAC ductwork, pound | - | - | 25,358 | - | - |
| 201 | Standard reinforced concrete, cubic yard | 904 | 1,192 | 2,231 | 2,947 | 887 |
| 202 | Grade slab concrete, cubic yard | - | - | 1,306 | 786 | - |
| 206 | Heavily rein concrete w/#9 rebar, cubic yard | - | - | 1,061 | 525 | - |
| 221 | Mechanical draft cooling tower, cubic yard | - | - | 40,976 | 40,976 | - |
| 222 | Hollow masonry block wall, cubic yard | - | - | - | 40 | - |
| 229 | Backfill of below grade voids, cubic yard | 467 | 467 | 13,269 | 5,142 | 763 |
| 235 | Building by volume, cubic foot | 19,980 | 19,980 | 699,705 | 837,085 | 28,665 |
| 236 | Building metal siding, square foot | - | - | 35,600 | - | - |
| 242 | Standard asphalt roofing, square foot | - | - | 10,000 | - | - |
| 255 | Overhead cranes/monorails >10 - 50 ton capacity, each | - | - | 2 | 1 | - |
| 260 | Structural steel, pounds | 80,500 | 99,347 | 6,012,653 | 3,942,572 | 207,586 |
| 262 | Steel floor grating, square foot | - | - | 18,519 | 8,619 | - |
| 268 | Placement of scaffolding in clean areas, square foot | - | - | 29,849 | 15,561 | - |
| 270 | Landscaping with topsoil, acre | - | - | 2 | 1 | 1 |
| 271 | Landscaping w/o topsoil, acre | 1 | 1 | 15 | 15 | - |
| 272 | Chain link fencing, linear foot | 1,000 | 1,000 | 2,000 | 4,000 | 1,000 |
| 274 | Asphalt pavement, square foot | 6,000 | 6,000 | 16,000 | 16,000 | 2,000 |
| 291 | Carbon steel plate 1/4 inch thick, square foot | 9,222 | 9,222 | - | - | 21,782 |
| 294 | Carbon steel plate 1/2 inch thick, square foot | - | - | 4,259 | 4,259 | - |
| 359 | Steam drum removal (fossil) | - | - | 2 | 1 | - |
| 360 | Water drum removal (fossil) | - | - | 2 | - | - |
| 361 | Upper/lower waterwall headers (fossil) | - | - | 13 | 10 | - |
| 362 | Top sup boiler waterwall (8'x8' section), inches cut | - | - | 64,337 | 45,775 | - |
| 369 | Boiler convective superheaater platens | - | - | 174 | 116 | - |
| 372 | Boiler economizer platens | - | - | 70 | 70 | - |
| 376 | Process ductwork (8'x8' section), inches cut | - | - | 217,199 | 131,984 | - |
| 378 | Non-asbestos insulated regenerative air preheaters | - | - | 1 | - | - |
| 381 | Non-insulated recuperative air preheaters | - | - | 4 | 4 | - |
| 382 | Induced, forced, primary draft fans | - | - | 4 | 2 | - |

# APPENDIX C

## UNIT COST FACTOR DEVELOPMENT

# APPENDIX C

## UNIT COST FACTOR DEVELOPMENT

Example: Unit Factor for Removal of Heat Exchanger < 3,000 pounds

## 1. SCOPE

Heat exchangers weighing < 3,000 lb. will be removed in one piece using a crane or small hoist. They will be disconnected from the inlet and outlet piping. The heat exchanger will be sent to the laydown area.

## 2. CALCULATIONS

| Act ID | Activity Description | Activity Duration | Critical Duration |
|---|---|---|---|
| a | Remove insulation | 20 | (b) |
| b | Mount pipe cutters | 60 | 60 |
| c | Disconnect inlet and outlet lines | 60 | 60 |
| d | Rig for removal | 30 | 30 |
| e | Unbolt from mounts | 30 | 30 |
| f | Remove, send to packing area | 60 | 60 |
| | Totals (Activity/Critical) | 260 | 240 |

| | |
|---|---|
| Duration adjustment(s): | |
| + Work break adjustment (8.33 % of productive duration) | 20 |
| Total work duration (minutes) | 260 |

***** Total duration = 4.333 hr *****

## 3. LABOR REQUIRED

| Crew | Number | Duration (hr) | Rate ($/hr) | Cost ($) |
|---|---|---|---|---|
| Laborers | 3.0 | 4.333 | 37.90 | 492.66 |
| Craftsmen | 2.0 | 4.333 | 50.48 | 437.46 |
| Foreman | 1.0 | 4.333 | 55.18 | 239.09 |
| General Foreman | 0.25 | 4.333 | 56.18 | 60.86 |
| Fire Watch | 0.05 | 4.333 | 37.90 | 8.21 |
| Total labor cost | | | | 1,238.28 |

## 4. EQUIPMENT & CONSUMABLES COSTS

| | |
|---|---|
| Equipment Costs | none |
| Consumables/Materials Costs | |
| Gas torch consumables 1 @ $10.10/hr x 1 hr {1} | 10.10 |
| Subtotal cost of equipment and materials | 10.10 |
| Overhead & profit on equipment and materials @ 15.30% | 1.55 |
| Total costs, equipment & material | 11.65 |
| **TOTAL COST Removal of heat exchanger <3000 pound:** | **$1,249.93** |
| Total labor cost: | $1,238.28 |
| Total equipment/material costs: | $11.65 |
| Total craft labor man-hours required per unit: | 27.298 |

## 5. NOTES AND REFERENCES

- Durations are shown in minutes. The integrated duration accounts for those activities that can be performed in conjunction with other activities, indicated by the alpha designator of the concurrent activity. This results in an overall decrease in the sequenced duration.

- Work difficulty factors were developed in conjunction with the AIF program to standardize decommissioning cost studies and are delineated in the "Guidelines" study (Reference 2, Vol. 1, Chapter 5).

- References for equipment and consumables costs:

    1. R.S. Means (2011) Division 01 54 33, Section 40-6360 Page 664

# APPENDIX D

# UNIT COST FACTOR LISTING

# TABLE D

## UNIT COST FACTOR LISTING

(Costs are in 2011 dollars/Scrap Weights in pounds)

| | Unit Cost Factors | | | | Scrap Weight | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UCF # | Description | Total Cost | Labor Cost | Labor Hours | Cast Iron | Carbon Steel No. 1 | Mixed Scrap | SS-1 | Galv. Steel. | Insul Cable | No. 2 Copper | Large Motor |
| 2 | Piping 0.25 to 2 inches diameter, linear foot | 4.47 | 4.44 | 0.1 | - | 4 | - | 0.5 | - | - | - | - |
| 3 | Piping >2 to 4 inches diameter, linear foot | 6.43 | 6.37 | 0.2 | - | 7 | - | 0.9 | - | - | 0.4 | - |
| 4 | Piping >4 to 8 inches diameter, linear foot | 12.56 | 12.49 | 0.3 | - | 22 | - | - | - | - | - | - |
| 5 | Piping >8 to 14 inches diameter, linear foot | 17.50 | 17.40 | 0.4 | - | 57 | - | - | - | - | - | - |
| 6 | Piping >14 to 20 inches diameter, linear foot | 25.04 | 24.74 | 0.6 | - | - | 120 | - | - | - | - | - |
| 7 | Piping >20 to 36 inches diameter, linear foot | 39.52 | 39.14 | 0.9 | - | - | 221 | - | - | - | - | - |
| 8 | Piping >36 inches diameter, linear foot | 48.21 | 47.82 | 1.1 | - | - | 417 | - | - | - | - | - |
| 9 | Valves <2 inches | 89.90 | 89.52 | 2.0 | - | - | - | - | - | - | - | - |
| 10 | Valves >2 to 4 inches | 83.89 | 83.30 | 1.9 | 75 | - | - | 8.8 | - | - | 4.4 | - |
| 11 | Valves >4 to 8 inches | 125.64 | 124.86 | 2.8 | 510 | - | - | - | - | - | - | - |
| 12 | Valves >8 to 14 inches | 174.97 | 174.00 | 4.1 | 1,066 | - | - | - | - | - | - | - |
| 13 | Valves >14 to 20 inches | 250.37 | 247.45 | 5.8 | - | - | 2,040 | - | - | - | - | - |
| 14 | Valves >20 to 36 inches | 395.22 | 391.35 | 9.1 | - | - | 3,334 | - | - | - | - | - |
| 15 | Valves >36 inches | 482.11 | 478.24 | 11.1 | - | - | 11,535 | - | - | - | - | - |
| 24 | Pipe hangers for small bore piping, each | 27.64 | 24.72 | 0.6 | - | 10 | - | - | - | - | - | - |
| 25 | Pipe hangers for large bore piping, each | 99.20 | 93.38 | 2.3 | - | 50 | - | - | - | - | - | - |
| 26 | Pump and motor set < 300 pounds | 211.11 | 206.26 | 4.7 | - | - | 50 | 12.5 | - | - | - | 62.3 |
| 27 | Pumps, 300-1000 pound pump | 587.22 | 579.45 | 12.7 | 293 | - | 49 | 48.9 | - | - | - | - |
| 28 | Pumps, >1000-10,000 pound pump | 2,325.08 | 2,313.43 | 51.3 | 2,834 | - | 472 | 472.3 | - | - | - | - |
| 29 | Pumps, >10,000 pound pump | 4,493.80 | 4,458.86 | 98.9 | 43,693 | - | 7,282 | 7,282.1 | - | - | - | - |
| 32 | Pump motors, 300-1000 pound pump | 246.68 | 246.68 | 5.4 | - | - | - | - | - | - | - | 307.8 |
| 33 | Pump motors, >1000-10,000 pound pump | 967.89 | 967.89 | 21.5 | - | - | - | - | - | - | - | 3,531.6 |
| 34 | Pump motors, >10,000 pound pump | 2,177.74 | 2,177.74 | 48.3 | - | - | - | - | - | - | - | 42,324.5 |
| 38 | Main turbine-generator (pounds per MW(e) input) | 143,236.28 | 142,490.98 | 3,042.0 | - | - | 851,500 | - | - | - | - | 851,500.0 |
| 39 | Heat exchanger <3000 pound | 1,249.93 | 1,238.28 | 27.3 | - | - | 416 | 623.4 | - | - | - | - |
| 40 | Heat exchanger >3000 pound | 3,142.43 | 3,095.85 | 68.3 | - | - | 5,599 | 8,397.9 | - | - | - | - |
| 41 | Feedwater heater/deaerator | 7,875.69 | 7,782.53 | 172.6 | - | - | 12,000 | 18,000.0 | - | - | - | - |
| 49 | Main condenser (pounds per MW(e) input) | 393,656.06 | 377,116.16 | 8,243.6 | 149,400 | - | 149,400 | 199,200.0 | - | - | - | - |
| 51 | Tanks, <300 gallons, filters, and ion exchangers | 271.64 | 265.82 | 6.0 | - | - | 401 | 401.2 | - | - | - | - |
| 52 | Tanks, 300-3000 gallons | 858.15 | 846.50 | 19.1 | - | - | 2,700 | 300.0 | - | - | - | - |
| 53 | Tanks, >3000 gallons, square foot surface | 7.19 | 7.04 | 0.2 | - | 21 | - | - | - | - | - | - |
| 54 | Electrical equipment, <300 pound | 115.36 | 115.36 | 2.6 | - | - | 56 | - | - | - | 2.9 | - |
| 55 | Electrical equipment, 300-1000 pound | 401.60 | 401.60 | 8.8 | - | - | 624 | - | - | - | 32.8 | - |
| 56 | Electrical equipment, 1000-10,000 pound | 803.22 | 803.22 | 17.6 | - | - | 2,212 | - | - | - | 116.4 | - |
| 57 | Electrical equipment, >10,000 pound | 1,918.68 | 1,918.68 | 41.0 | - | - | 19,950 | - | - | - | 1,050.0 | - |
| 59 | Electrical transformers < 30 tons | 1,332.50 | 1,332.50 | 28.4 | - | - | 11,250 | - | - | - | 3,750.0 | - |
| 60 | Electrical transformers > 30 tons | 3,837.37 | 3,837.37 | 81.9 | - | - | 375,000 | - | - | - | 125,000.0 | - |

## TABLE D (continued)

## UNIT COST FACTOR LISTING

(Costs are in 2011 dollars/Scrap Weights in pounds)

| Unit Cost Factors | | | | | Scrap Weight | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UCF # | Description | Total Cost | Labor Cost | Labor Hours | Cast Iron | Carbon Steel No. 1 | Mixed Scrap | SS-1 | Galv. Steel. | Insul Cable | No. 2 Copper | Large Motor |
| 64 | Fluorescent light fixture | 47.81 | 47.81 | 1.1 | - | - | - | - | - | - | - | - |
| 65 | Incandescent light fixture | 23.67 | 23.67 | 0.6 | - | - | - | - | - | - | - | - |
| 66 | Electrical cable tray, linear foot | 10.78 | 10.58 | 0.2 | - | - | - | - | 6.6 | 6.6 | - | - |
| 67 | Electrical conduit, linear foot | 4.71 | 4.61 | 0.1 | - | - | - | - | 3.4 | 3.4 | - | - |
| 69 | Mechanical equipment, <300 pound | 115.36 | 115.36 | 2.6 | - | - | 127 | - | - | - | - | - |
| 70 | Mechanical equipment, 300-1000 pound | 401.60 | 401.60 | 8.8 | - | - | 641 | - | - | - | - | - |
| 71 | Mechanical equipment, 1000-10,000 pound | 803.22 | 803.22 | 17.6 | - | - | 4,184 | - | - | - | - | - |
| 72 | Mechanical equipment, >10,000 pound | 1,918.68 | 1,918.68 | 41.0 | - | - | 11,938 | - | - | - | - | - |
| 76 | HVAC equipment, <300 pound | 139.50 | 139.50 | 3.1 | - | - | 184 | - | - | - | - | - |
| 78 | HVAC equipment, 1000-10,000 pound | 961.74 | 961.74 | 21.0 | - | - | 3,813 | - | - | - | - | - |
| 82 | HVAC ductwork, pound | 0.45 | 0.45 | 0.0 | - | - | - | - | 1.0 | - | - | - |
| 201 | Standard reinforced concrete, cubic yard | 65.77 | 28.78 | 0.6 | - | 183 | - | - | - | - | - | - |
| 202 | Grade slab concrete, cubic yard | 88.07 | 43.17 | 1.0 | - | 183 | - | - | - | - | - | - |
| 206 | Heavily rein concrete w/#9 rebar, cubic yard | 109.52 | 36.73 | 0.8 | - | 730 | - | - | - | - | - | - |
| 221 | Mechanical draft cooling tower, cubic yard | 2.95 | 2.06 | 0.0 | - | - | - | - | - | - | - | - |
| 222 | Hollow masonry block wall, cubic yard | 86.04 | 54.53 | 1.4 | - | 66 | - | - | - | - | - | - |
| 229 | Backfill of below grade voids, cubic yard | 29.55 | 2.94 | 0.1 | - | - | - | - | - | - | - | - |
| 235 | Building by volume, cubic foot | 0.27 | 0.15 | - | - | - | 1 | - | - | - | - | - |
| 236 | Building metal siding, square foot | 1.03 | 0.80 | 0.0 | - | - | - | - | 2.4 | - | - | - |
| 242 | Standard asphalt roofing, square foot | 1.98 | 1.98 | 0.1 | - | - | - | - | - | - | - | - |
| 255 | Overhead cranes/monorails >10 - 50 ton capacity, each | 1,353.09 | 1,353.09 | 28.3 | - | - | 298,832 | - | - | - | 3,018.5 | - |
| 260 | Structural steel, pounds | 0.19 | 0.14 | - | - | 1 | - | - | - | - | - | - |
| 262 | Steel floor grating, square foot | 4.04 | 3.84 | 0.1 | - | - | 6 | - | 1.1 | - | - | - |
| 268 | Placement of scaffolding in clean areas, square foot | 15.94 | 4.17 | 0.1 | - | - | - | - | - | - | - | - |
| 270 | Landscaping with topsoil, acre | 26,812.44 | 2,434.70 | 52.6 | - | - | - | - | - | - | - | - |
| 271 | Landscaping w/o topsoil, acre | 1,047.09 | 269.21 | 5.3 | - | - | - | - | - | - | - | - |
| 272 | Chain link fencing, linear foot | 2.93 | 2.27 | 0.1 | - | - | - | - | 10.0 | - | - | - |
| 274 | Asphalt pavement, square foot | 0.79 | 0.52 | 0.0 | - | - | - | - | - | - | - | - |
| 291 | Carbon steel plate 1/4 inch thick, square foot | 3.13 | 2.53 | 0.1 | - | - | 10 | - | - | - | - | - |
| 294 | Carbon steel plate 1/2 inch thick, square foot | 3.30 | 2.66 | 0.1 | - | - | 20 | - | - | - | - | - |
| 359 | Steam drum removal (fossil) | 16,916.15 | 16,838.51 | 411.6 | - | - | 480,000 | - | - | - | - | - |
| 360 | Water drum removal (fossil) | 6,283.12 | 6,268.57 | 153.2 | - | - | 320,000 | - | - | - | - | - |
| 361 | Upper/lower waterwall headers (fossil) | 4,740.67 | 4,726.12 | 115.5 | - | - | 120,000 | - | - | - | - | - |
| 362 | Top sup boiler waterwall (8'x8' section), inches cut | 0.57 | 0.55 | 0.0 | - | - | 11 | - | - | - | - | - |
| 369 | Boiler convective superheaater platens | 1,344.83 | 1,243.91 | 29.6 | - | - | 19,501 | - | - | - | - | - |
| 372 | Boiler economizer platens | 724.10 | 669.76 | 15.9 | - | - | 11,703 | - | - | - | - | - |
| 376 | Process ductwork (8'x8' section), inches cut | 0.28 | 0.27 | 0.0 | - | - | 0 | - | - | - | - | - |
| 378 | Non-asbestos insulated regenerative air preheaters | 8,620.58 | 7,712.25 | 188.5 | - | - | 1,376,000 | - | - | - | - | - |
| 381 | Non-insulated recuperative air preheaters | 4,390.24 | 3,867.94 | 93.4 | - | - | 1,376,000 | - | - | - | - | - |
| 382 | Induced, forced, primary draft fans | 1,363.04 | 1,339.75 | 31.9 | - | - | 30,000 | - | - | - | - | 3,531.6 |