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7. Abstract

This study provides alternatives for replacing the overhead signal cable system in the 300 area. Cost estimates and recommendations are provided.

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300 AREA SIGNAL CABLE STUDY

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September 7, 1994

EXECUTIVE SUMMARY

This report was prepared to discuss the alternatives available for removing the 300 Area overhead signal cable system. This system, installed in 1969, has been used for various monitoring and communication signalling needs throughout the 300 Area. Over the years this cabling system has deteriorated, has been continually reconfigured, and has been poorly documented to the point of nonreliability. Furthermore, with removal of the overhead powerlines under projects B-524 and L-047, the above ground poles will be able to be removed once the remaining cable systems are eliminated. Therefore, this report provides for two objectives; proposing a more reliable communication pathway for the various signalling needs, and eliminating the overhead cable for eventual pole removal. Because of the latter objective, other systems utilizing the above ground poles were also referenced but were not expanded upon as they were not in the scope of this study (i.e. not a part of the signal cable system). The only exception was the accountability aid phones which still operate over the old GTE North West (GTENW) phone lines. This system was examined since it is part of the 300 Area warning system.

The first step was to look at the systems utilizing the overhead signal cable that are still required for operation. Of the ten systems that once operated via the signal cable, only five are still required; the civil defense evacuation alarms, the public address (PA) system, the criticality alarms, the Pacific Northwest Laboratory Facilities Management Control System (FMCS), and the 384 annunciator panel. Of these five, the criticality alarms and the FMCS have been dealt with under other proposals. Therefore, this study focused on the alternatives available for the remaining three systems (evacuation alarms, PA system, and 384 panel) plus the accountability aid phones.

Once the systems to be discussed were determined, then three alternatives for providing the signalling pathway were examined for each system; 1. Re-wire using underground communication ducts, 2. Use the Integrated Voice/Data Telecommunications System (IVDTS) already installed and operated by U.S. West, and 3. Use radio control. Each alternative was developed with an estimated cost, advantages, and disadvantages. Finally, a recommendation was provided for the best alternative for each system.

For the evacuation alarms and PA system, the recommendation is to combine these systems into one and utilize radio control as the communication pathway to take advantage of integrating with the site wide siren network presently being installed. The total cost is estimated at nearly $950K (K = x thousand) plus $36K/year for maintenance.

The recommendation for the 384 annunciator panel is to utilize the IVDTS network to take advantage of the expandable network and quick spare reconnect in the event of any cable failure. The estimated cost is approximately $210.6K plus $16K/year for maintenance. In addition, circuit fees of $19.2K/year will be imposed until billing arrangements are finalized with U.S. West (assumed to be less than one year), then will drop to $5.4K/year. These circuit fees cover all maintenance of the IVDTS lines with the extra maintenance cost covering the internal equipment.

The IVDTS network is also recommended for the accountability aid phones. This will provide for an easy, familiar to use system, and eliminate additional training for the staging area directors. It will also provide a reliable communication system for long term conversations during an emergency which would be unavailable utilizing a battery operated network such as radio. The cost for this is estimated at nearly $140.4K plus $5.5K/year for maintenance. The initial circuit fees will be $14.4K reducing to $3.9K per year similar to the 384 panel case cited above.

This report provides for the removal of the overhead signal cable system by providing recommendations for alternative communication pathways for the required needs. However, it is not intended to provide any detail design on how to accomplish these changes. This type of definitive design would have to take place in the next phase once the recommendations are approved and funded. This study is a good starting point in outlining the systems that will have to be maintained and provided for in the event the signal cable system is removed. It also outlines the other systems, not in scope, that utilize the overhead poles and will also have to be provided for to complete any pole removal project.

TABLE OF CONTENTS

1.0 INTRODUCTION

The 300 Area signal cable system provides the pathway for transmitting and receiving various alarm signals from multiple points within the 300 Area (see list of systems below). Installed in 1969 and continually modified, the system is comprised of input signals from selected buildings, twelve main overhead trunk lines, common central junction boxes in the 3706 Building, and output signals to about half of the 300 Area buildings. Because of its age, deterioration of many parts of the system has occurred causing cable failure and false alarms due to short circuits. The system has been patchworked together utilizing spares when primary cable pairs have failed causing increased overloading conditions. Because of the modifications and patchwork nature of the system much of the documentation is unreliable.

2.0 PURPOSE AND SCOPE

Several studies have been completed providing options for upgrading this system. However, these studies either looked at replacing the overhead cables with additional overhead lines or routing totally new underground lines or did not totally encompass all of the existing systems. Since these studies were completed, other options have been made available and many of the signalling capabilities are no longer needed. Also, with projects such as B-524 and L-047 removing the overhead power lines, it would make sense to entirely eliminate the overhead signal cables to allow for removal of the existing poles. Many of these poles are nearing their design life and removal or replacement is necessary. Removing these poles would also allow for completion of the West parking lot area upgrade and provide better traffic safety.

Therefore, this study will define which signalling needs are still required and outline the options available for removing the overhead lines by providing alternative transmission/receiving systems to carry out such functions. Because this study looks at removing the overhead lines for eventual pole removal, other signalling requirements were looked at in addition to the overhead signal cable. These other systems will be identified below but will not be expanded upon since they are being examined by Boeing Computer Services, Richland (BCSR) engineers who will determine the most appropriate method for relocation of the required systems.

This report is not intended to provide all the detail required for definitive design work. Instead, it serves to outline the recommended alternatives and provide resource information for any eventual definitive design to be initiated.

3.0 EXISTING SYSTEMS

Civil Defense Evacuation Alarms

This system provides evacuation and take cover alarms both internal to specific buildings and external to the general area.

Public Address System

This system provides voice message announcements to outside staging areas.

Battelle Northwest (BNW) Security Signals

These signals are comprised of the 303-C building intrusion alarm, various Pacific Northwest Laboratories (PNL) intrusion alarms, and Test Reactor and Isotope Production, General Atomics (TRIGA) alarms.

Criticality Alarms

Provides criticality signalling from specified buildings to 3701D (3701D is the old patrol headquarters which houses the monitors and control panels for many of these systems).

Area Surveillance Recorders

Provides security monitoring at the 3701D Building.

TRIGA Remote Shutdown Switch

Remote shutdown for TRIGA at the 3701D Building.

FFTF Evacuation Signal

Remote signalling of Fast Flux Test Facility (FFTF) evacuation alarm at 3701D.

FFTF Sound Powered Communication

Sound powered phone line between FFTF and 3701D.

PNL FMCS

The PNL Facilities Management Control System (FMCS) is a computerized facilities monitoring system.

384 Powerhouse Annunciator Panel

This is a remote annunciator panel which provides status of several 300 area building alarms such as the chlorine alarm for the 315 Building, etc.

Accountability Aid Phones

This system consists of eleven phones throughout the 300 Area emergency staging areas and the 300 Area Emergency Control Center (ECC). This allows conference communications for emergency instructions. This system is part of the old GTENW phone lines but will be addressed by this report.

The above systems are those that were identified through various drawings and reports, conversations with building managers, U.S. West representatives, and BCSR telecommunication engineers (see Appendix A). This should be a complete

list of systems utilizing the overhead signal cables. However, any undocumented additions to this system would only be able to be identified by circuit tracing each cable pair. This type of identification would be costly and time consuming. Given the response of the building managers and telecommunication engineers, any undocumented systems are probably no longer needed and would not warrant identification.

3.1 EXISTING SYSTEMS NOT IN SCOPE

The following systems utilize the existing poles for support but are not part of the actual signal cable network. These systems will be discussed for reference of the remaining aerial cables that need to be examined before the poles can be removed.

HLAN Fiber, Broadband Cable, and SCADA Circuits

These three systems are addressed as one because current BCSR plans for providing an underground fiber network will allow for removal of all three systems from the overhead lines. A proposal has been submitted by BCSR that will relocate these systems to underground utilizing project B-524 funds. Because this proposal has been prepared and these systems are outside the scope of this study, no further discussion of these systems is provided in this report.

Video Coaxial Cable

This system provided video monitoring of the 339A Building and other video surveillance for the 300 Area by the old Security Operations Center in the basement of the 3701D Building. It has been abandoned and is no longer needed (this system may actually have been routed via fiber cable since some of the documentation and BCSR engineer's accounts conflict, but no further investigation was done since it is no longer required). Therefore, no further discussion is required for this system, and it may be removed.

4.0 RECOMMENDATIONS

Of the listed signalling needs under 3.0, the only ones still required for operation are the evacuation alarms, PA system, criticality alarms, FMCS, 384 annunciator panel, and the accountability aid phones. The remainder of the systems are either deactivated or simply no longer used.

While the criticality alarms are still needed, the Emergency Preparedness (EP) group of WHC has determined they are only required to be controlled at each individual facility. Therefore they no longer require operation utilizing the overhead signal cable. Next, PNL has completed recommendations on converting the FMCS to a fiber optic system or to the Hanford Local Area Network (HLAN) for their monitoring needs. Their proposal has been accepted and funded for $300K under project L-249 "PNL Signal Cable Replacement." So, neither the criticality system nor the FMCS will be addressed by this report.

The recommended alternative for providing the signalling needs of the evacuation alarms and PA system is to combine these systems into one and

utilize radio communication to achieve operability. This will allow for integration into the sitewide siren network and provide faster response during emergencies. The estimated cost for providing a radio controlled siren/PA system is approximately $950K (see Appendix B for estimate breakdowns) plus $36K/yr for maintenance (see note on maintenance under A1 of Appendix B).

The recommended signalling pathway for both the 384 annunciator panel and the accountability aid phones is the Integrated Voice/Data Telecommunications System (IVDTS) network. The IVDTS network will provide a reliable, well maintained pathway and have the capability of providing for quick spare reconnect in the event of any cable pair failure. The cost for switching the 384 annunciator panel to IVDTS is approximately $210.6K with annual circuit fees of $19.2K (see note on circuit fees under A2 of Appendix B) reducing to about $5.4K per year once billing arrangements are finalized with U.S. West plus $16K/yr for maintenance. The cost for switching the accountability aid phones to IVDTS is approximately $140.4K with annual circuit fees of $14.4K reducing to about $3.9K per year, again, once billing arrangements are finalized plus $5.5K/yr for maintenance.

5.0 DISCUSSION

The first step in studying the replacement of the overhead signal cable was to verify which systems were still required and being used. As shown in Appendix A, many drawings and knowledgeable individuals were consulted. Through researching the drawings and discussions with the responsible individuals, it was determined that the only systems of those outlined in section 3.0 that are still required are the civil defense evacuation alarms, PA system, criticality alarms, PNL FMCS, 384 powerhouse annunciator panel, and the accountability aid phones.

According to the Emergency Preparedness group, the criticality alarms were cut over to individual facility control and no longer require use of the overhead lines. Also, the PNL FMCS is already planned for removal from the overhead system and has been granted funding of $300K under project L-249 "PNL Signal Cable Replacement" to complete this task. Therefore, no further options for these systems have been investigated for this report.

To determine the appropriate upgrade for the remaining systems, each was examined separately to determine its function and future needs. Then, three alternatives were compared for each system. The first was to simply rewire the overhead system into an underground distribution system. The next alternative was to use the IVDTS network for the signalling needs. The final alternative was to utilize radio communications to provide the signalling pathway.

6.0 ANALYSIS

In the analysis to follow, each system is discussed and the alternatives are outlined by cost, advantages, and disadvantages. Finally, a recommendation is provided with an associated explanation based on the best alternative for that system. The cost estimates for each alternative are detailed in Appendix B. These estimates are intended to be rough estimates for comparative purposes.

Once the final alternative is selected for each system a more detailed estimate should be prepared.

6.1 Civil Defense Evacuation Alarms and Public Address System

The first system studied was the 300 area civil defense evacuation alarms and public address (PA) system. The civil defense alarms are comprised of 42 internal building alarms and seven (five of which are still active) externally mounted rooftop alarms for general area warning. The alarms are centrally controlled via the central control panel located in the basement of the 3701D Building with a relay extension to the 384 powerhouse for remote activation. Upon activation, a 48 volt DC signal is sent across the overhead cable lines to each local control panel within the 42 facilities. This signal activates a relay at the local panel for operation of the internal sirens as well as the external sirens at five of the facilities.

The PA system operates independently from the alarms and consists of seven external locations for general area announcements during an emergency. Upon activation a 25 volt signal is transmitted to the speaker amplifiers which output a 70 volt AC signal to the speaker cells. The current PA system is inaudible throughout many portions of the 300 Area.

These two systems were analyzed together since they serve as complements to one another during a general area emergency.

Alternative 1: Re-wire Using Underground Communication Ducts

Cost: $2180.1K + $73.5K/yr for maintenance.

Advantages: Ownership of lines, secured circuits.

Disadvantages: Highest initial cost, high maintenance costs, difficult to expand system, uses existing deteriorating alarm system with no upgrade, cannot integrate into site wide warning system.

Alternative 2: Use IVDTS Network

Cost: $731.6K + $52.8K/yr circuit fees reducing to $15.6K once billing arrangements are finalized with U.S. West + $49.0K/yr for maintenance.

Advantages: Lowest initial cost, quick spare reconnect and system expandability, secured circuits, upgraded PA system.

Disadvantages: Uses existing deteriorating alarm equipment, high initial circuit fees, cannot integrate into site wide warning system.

Alternative 3: Use Radio Controlled Communications

Cost: $949.3K + $36.0K/yr for maintenance.

Advantages: Completely upgraded system, combines PA and alarms into one system greatly enhancing coverage area, can integrate into site wide warning system, quick expandability, easier troubleshooting through computer diagnostics on upgraded system.

Disadvantages: Nonsecured circuits (subject to radio interference), FCC frequency allocation required (if integrated into site system, this frequency is available).

Recommendation

The recommended alternative is to utilize radio controlled communications. Though it is initially more expensive to implement than using IVDTS, the end result will be a much better system with capabilities beyond those available under the IVDTS alternative. Furthermore, taking into account the circuit and maintenance fees, the difference is eliminated in nearly six years assuming the circuit fees are reduced after just one year (see Appendix B for payback period calculations). This savings results from the difference in the number of buildings requiring alarms under both systems. By integrating with the site wide system, some buildings currently with internal sirens would no longer need them. The outside sirens would be sufficient to cover nine of the existing 42 buildings (see Appendix C). Also, the site wide system would combine both the PA and alarms into one system thereby increasing coverage of the PA announcements. However, if no integration occurs, as under the IVDTS scenario, then all 42 buildings would need to be reconnected as well as all seven outside PA speakers. So, under the radio controlled system only 33 facilities and three external sirens would need to be connected resulting in less maintenance fees and a payback period of nearly six years.

The actual difference will be eliminated much sooner than six years though for a number of reasons. First, because the existing system is so deteriorated and unreliable, it is in need of upgrade anyway, which was not taken into account in the IVDTS estimate. Also, because the radio control system calls for immediate upgrade, enhanced diagnostics will be made available resulting in less engineering time required to troubleshoot system problems.

The above recommendation assumes integration with the site wide warning system. This will save over $300K. If integration is not implemented, then the radio system would need to be expanded to cover all 42 facilities which would result in the additional cost.

6.2 384 Powerhouse Annunciator Panel

The 384 Powerhouse annunciator panel is a remote monitoring station for 15 facilities within the 300 Area. The panel is located in the control room of the 384 powerhouse which is a 24 hour manned facility. Any alarm on the system that is activated at the local facility will also transmit a 24 VDC signal (this should be field verified before any design) via the overhead signal cable to this remote annunciator panel. The alarms consist of chlorine leak detection, radiation alarms, and various other common alarms that are

critical to the safety and security of the 300 Area personnel. This system must be maintained and operable at all times.

Alternative 1: Re-wire Using Underground Communication Ducts

Cost: $772.2K + $24.0K/yr for maintenance.

Advantages: Ownership of lines, secured circuits, utilizes existing system.

Disadvantages: Highest initial cost, high maintenance cost, difficult to expand system.

Alternative 2: Use IVDTS Network

Cost: $210.6K + $19.2K/yr circuit fees reducing to $5.4K/yr once billing arrangements are finalized with US West + $16.0K/yr for maintenance.

Advantages: Lowest initial cost, quick spare reconnect and system expandability, secured circuits, utilizes existing equipment.

Disadvantages: High initial circuit fees.

Alternative 3: Use Radio Controlled Communications

Cost: $397.8K + $16.0K/yr for maintenance.

Advantages: Expandable system, multiple control points.

Disadvantages: Nonsecured circuits (subject to radio interference), FCC frequency allocation, would require new radio control panels and additional hardware (antennas, etc.).

Recommendation

The recommended alternative is to utilize the IVDTS network. The cost for rewiring is considerably higher with no real advantages. The payback for using a radio controlled system is a little over 32 years assuming the circuit fees under IVDTS are reduced after the first year. Unlike the siren/PA system, no advantages exist for the annunciator panel to switch to radio since there is no site wide integration required nor available. Furthermore, the existing equipment is in relatively good condition and so is not in need of immediate replacement as in the siren/PA case. Therefore, IVDTS would provide the best alternative for a communications pathway. It offers quick spare reconnect in the event of a cable pair failure which would provide high reliability for this critical system. It also allows the ability to expand the system if needed in the future at a low marginal cost. According to BCSR engineers, the time for changeover is virtually immediate once the circuits are identified. This will allow for the least interruption to the existing service.

6.3 Accountability Aid Phones

The accountability aid phones are a bank of 11 phones interconnected via the old GTENW phone lines in a conference bridge network. This allows communication between all phones at the same time. There are eight phones located at the various staging areas and three inside the 300 Area ECC. During an emergency, the staging area directors are able to communicate via these phone lines with the emergency coordinator in the ECC to receive instructions and information pertaining to the existing emergency.

Alternative 1: Re-wire Using Underground Communication Ducts

Cost: $288.6K + $15.0K/yr for maintenance.

Advantages: Ownership of lines, secured circuits.

Disadvantages: Highest initial cost, high maintenance costs, difficult to expand system, not practical for phone system without additional equipment not specified in estimate.

Alternative 2: Use IVDTS Network

Cost: $140.4K + $14.4K/yr circuit fees reducing to $3.9K/yr once billing arrangements are finalized with U.S. West + $5.5K/yr for maintenance.

Advantages: Quick spare reconnect and system expandability, secured circuits, utilizes existing equipment, staging area directors familiar with use of phones, no training required for use.

Disadvantages: High initial circuit fees.

Alternative 3: Use Radio Controlled Communications

Cost: $117.0K + $5.5K/yr for maintenance.

Advantages: Lowest initial cost, quick expandability, mobile communications.

Disadvantages: Nonsecured circuits (subject to radio interference), FCC frequency allocation required, training required for use.

Recommendation

The recommended alternative is to utilize the IVDTS network for this system. Rewiring the circuits will provide no advantages but would be extremely expensive and require additional equipment for operation. Use of radio control provides no real advantages either but would require additional training to personnel familiar with the use of phones. The cost difference between IVDTS and radio control is too insignificant given the percent error apparent in these estimates. Therefore the decision lies between the

advantages and disadvantages of IVDTS versus radio control without regard to cost.

The advantages are in favor of switching to IVDTS. The Emergency Preparedness group would rather maintain the existing phone system as is to avoid having to retrain the staging area directors. While the training would be minimal, the staging area directors may change frequently and may be personnel with nontechnical skills unfamiliar with radio operating procedures. Most everyone, however, is familiar with the use of the telephone. Also, radios would require periodic battery replacement. Should these fail to be replaced or be exhausted during an emergency, communications would be disrupted (Cellular phones were considered to have similar disadvantages as radio in terms of power requirements and also have per minute usage charges which are mandated to be minimized by DOE, therefore no further consideration was given to this alternative). Finally, in the event it became necessary, an offsite call to emergency services could be made by each staging area director, if a telephone was available, but would require routing through the ECC if radios were used. Since in an emergency timing is critical, the added delay or inability to make this direct call could result in a more severe emergency or loss of life. Therefore, retaining the existing telephone equipment by switching over to IVDTS provides the safest and best alternative for operation of the accountability aid phone system.

APPENDIX A - REFERENCES

Drawing References

Drawing Title	Drawing Number
Public Address System for 300 Area Evacuation	H-3-27749
Electrical Alarm Signal Cables 300 Area Plot Plan	H-3-28724
Electrical Alarm Signal Cables Cable Scheduling Diagrams	H-3-28725
Electrical Alarm Signal Cables Building Installations Plans & Elevations	H-3-28726
Electrical Civil Defense Evacuation System Elementary Diagram	H-3-28727
Electrical Civil Defense Evacuation System Console Wiring Diagram	H-3-28728
Electrical Alarm Signal Cables 600 Pair Cable Terminal Box #3706 Wiring Diagram	H-3-28730
Electrical Alarm Signal Cables Building Installations Plans & Elevations	H-3-28731
Electrical Alarm Signal Cables Building Installations Plans & Elevations	H-3-28732
Electrical Alarm Signal Cables Building Installations Plans & Elevations	H-3-28733
Electrical Signal Cable Interconnection 309 to 3706 Bldg.	H-3-32838
Video Cable Pole Plan & Details	H-3-34107
Video Cable Bldg Sections & Details	H-3-34109

Electrical Alarm Signal Cable Extension to BLDG 3763	H-3-39067
300 Area Civil Defense Siren Additions	H-3-44456
Electrical 300 Area P.A. & CD Siren Extension to 337 BLDG	H-3-44737
Alarm Signal Cable and Video Coax Undergrounding Cable "D" & "L" Plan, Profiles & Details	H-3-47204
Broadband Cable Routing	H-3-52877
FMCS Signal Block Diagram	H-3-54071
Facilities Management Control System	H-3-54076
Elec. Alarm Signal Cables Wiring Diagram	H-3-56611
300 Area Emergency Planning Map	H-3-57341
Telecommunications SCADA 10,352C-251B CKT. Record	H-3-70006

Previous Studies & Reports

Preliminary Engineering Study 300 Area Signal Cable System Replacement December 1987, K. D. Hayden	PES-W-91-L-ARL-004
Functional Design Criteria Signal Cable System Replacement	SD-L004-FDC-001 Rev 0
Additional Requirements For Integrated Voice/Data Telecommunications System For The 300 Area, August 1988, F. R. Buck	

Points of Contact

Name	Company	MSIN	Telephone	Systems
Brown, Bob US West Rep.	US West	L7-12	372-8810	IVDTS
Buck, Fred Infrastructure & Facilities	BCSR	H1-62	376-9015	ALL

Burris, Jack Facilities Engineering	PNL	P7-63	376-1490	FMCS
Cortez, Morris 300A Steam Plant Maintenance	KEH	L8-22	376-1819	384 Powerhouse Annunciator
Harden, Nat 300A Steam/Water Utilities	KEH	L6-79	376-6353	384 Powerhouse Annunciator
Morales, Ted 300A EP Rep.	WHC	L7-98	376-8366	Evac. alarms, PA, Acc. Aid Phones
Olson, Marv Facilities Engineering	PNL	P7-63	376-2198	FMCS
Palmer, RH(Dick) EP Manager	WHC	R2-58	373-4689	Evac. alarms, PA, Acc. Aid Phones

APPENDIX B - ESTIMATES

The dollar amounts for the estimates to follow were obtained from several sources. Primarily, the estimates for the underground routing and the IVDTS were provided through consultation with BCSR engineers. The figures for radio control were taken from a similar project under way in the 100 Area. Also, past reports and studies were used in comparison which closely paralleled the results of this study. The estimates herein are not intended to be precise but more of an order of magnitude cost for comparative purposes.

A. Civil Defense Evacuation Alarms & PA Systems

1. **Re-wiring Using Underground Conduit:**

ALARMS

ITEM	COST
Construction/Wiring	$ 10.0K
Facility Modifications (Core Drilling, Conduit runs, etc.)	$ 10.0K
Engineering Support	$ 5.0K
Drawings	$ 5.0K
SUBTOTAL	$ 30.0K/facility
X	42 facilities
TOTAL	$1260.0K

PA SYSTEM

ITEM	COST
Construction/Wiring	$ 10.0K
Engineering Support	$ 2.5K
Drawings	$ 5.0K
SUBTOTAL	$ 17.5K/Location
X	7 Locations
TOTAL	$ 122.5K

ITEM	COST
Alarm Total	$1250.0K
PA Total	$ 122.5K
ATP(Acceptance Test Plan)	$ 15.0K
SUBTOTAL 1	$1397.5K
+Construction Management/Overheads(30%)	$ 419.3K
SUBTOTAL 2	$1816.8K
+Contingency (20%)	$ 363.3K
GRAND TOTAL	**$2180.1K**
MAINTENANCE*	$ 1.5K/yr/location
X	49 Locations

TOTAL	$ 73.5K/yr.

*Note: Maintenance includes cost of checking connections, checking equipment, periodic testing and other such functions necessary to maintain system readiness. Under IVDTS, maintenance of the communication lines is provided under the circuit fees so a reduced maintenance cost is given which provides for the remainder of the system.

2. **IVDTS**

ALARMS

ITEM	COST
Installation	$ 2.0K
Engineering Support	$ 5.5K
SUBTOTAL	$ 7.5K/facility
X	42 facilities
TOTAL	$ 315.0K

PA SYSTEM

Since portions of the PA System are incompatible with the IVDTS network, this part of the estimate uses radio control for the communications pathway. If the alarms are put on IVDTS then seven locations are required for the PA System plus a base station controller.

ITEM	COST
Equipment	$ 8.5K
Installation	$ 6.0K
Engineering Support	$ 1.5K
Drawings	$ 1.0K
SUBTOTAL	$ 17.0K/Locations
X	7 Locations
TOTAL	$ 119.0K

BASE STATION

ITEM	COST
Equipment	$ 7.5K
Engineering Support	$ 1.5K
Drawings	$ 5.0K
Installation	$ 6.0K
TOTAL	$ 20.0K

ITEM	COST
Alarm Total	$ 315.0K
PA System	$ 119.0K

Base Station	$ 20.0K
ATP	$ 15.0K
SUBTOTAL 1	$ 469.0K
+Construction Management/Overheads(30%)	$ 140.7K
SUBTOTAL 2	$ 609.7K
+Contingency(20%)	$ 121.9K
GRAND TOTAL	**$ 731.6K**

CIRCUIT FEES*

*NOTE: Under the IVDTS network, there are monthly circuit fees which cover maintenance, spare reconnect, and other such items necessary for continuity of service. Currently, the per circuit fees are higher than what they will stabilize to once all billing arrangements are in place to provide for a more equitable distribution of charges. All estimates for using IVDTS will use the initial fees of $105/mo. per circuit for the first year, then $30/mo. per circuit thereafter. The time for actual changeover to the lower rate may be greater or lesser than the one year, but this provides a good transition point for comparing estimates.

Initial	$ 105/mo per circuit
X	42 circuits
SUBTOTAL	$ 4.4K/mo
X	12/mo
TOTAL	$ 52.8K/yr
After billing arrangements	$ 30/mo per circuit
X	42 circuits
SUBTOTAL	$ 1.3K/mo
X	12 mo
TOTAL	$ 15.6K/yr
MAINTENANCE	$ 1.0K/yr/location
X	49 Locations
TOTAL	$ 49.0K/yr.

3. **Radio Control**

If radio control is utilized and integrated with site wide system then only 33 facilities will require internal alarms. Also, there will only be three external locations required. This system will combine both the alarms and PA System into one allowing for extended coverage.

INTERNAL SYSTEM

ITEM	COST
Controller, other hardware	$ 8.5K
Engineering Support	$ 1.5K

Drawings	$ 1.0K
Installation	$ 4.0K
SUBTOTAL	$ 15.0K/facilities
X	33 facilities
TOTAL	$ 495.0K

EXTERNAL SYSTEM

ITEM	COST
Siren Equipment	$ 51.0K
Engineering Support	$ 5.0K
Drawings	$ 15.0K
Construction/Installation	$ 22.5K
Misc. Hardware	$ 5.0K
TOTAL	$ 98.5K

ITEM	COST
Internal Installation Total	$ 495.0K
External Installation Total	$ 98.5K
ATP	$ 15.0K
SUBTOTAL 1	$ 608.5K
+Construction Management/Overheads(30%)	$ 182.6K
SUBTOTAL 2	$ 791.1K
+Contingency	$ 158.2K
GRAND TOTAL	**$ 949.3K**
MAINTENANCE	$ 1.0K/yr/location
X	36 Locations
TOTAL	$ 36.0K/yr.

B. 384 Powerhouse Annunciator Panel

1. **Re-wiring Using Underground Conduit:**

Per facility charges same as A1	$ 30.0K/facility
X	16 facilities
TOTAL	$ 480.0K
ATP	15.0K
SUBTOTAL 1	$ 495.0K
+Construction Management/Overheads(30%)	$ 148.5K
SUBTOTAL 2	$ 643.5K
+Contingency (20%)	$ 128.7K
GRAND TOTAL	**$ 772.2K**
MAINTENANCE	$ 1.5K/yr per facility
X	16 facilities
TOTAL	$ 24.0K/yr

2. **IVDTS**

Per facility charges same as A2	$ 7.5K
X	16 facilities
TOTAL	$ 120.0K
ATP	$ 15.0K
SUBTOTAL 1	$ 135.0K
+Construction Management/Overheads(30%)	$ 40.5K
SUBTOTAL 2	$ 175.5K
+Contingency (20%)	$ 35.1K
GRAND TOTAL	**$ 210.6K**

CIRCUIT FEES See *Note Under A2

Initial	$ 105/mo per circuit
X	15 circuits
SUBTOTAL	$ 1.6K/mo
X	12 mo
TOTAL	$ 19.2K/yr
After billing arrangements	$ 30/mo per circuit
X	15 circuits
SUBTOTAL	$ 450/mo
X	12 mo
TOTAL	$ 5.4K/yr
MAINTENANCE	$ 1.0K/yr/location
X	16 Locations
TOTAL	$ 16.0K/yr

3. **Radio Control**

The cost per facility would closely parallel the cost under A3.

Per facility charges same as A3	$ 15.0K/facility
X	16 facilities
TOTAL	$ 240.0K
ATP	$ 15.0K
SUBTOTAL 1	$ 255.0K
+Construction Management/Overheads(30%)	$ 76.5K
SUBTOTAL 2	$ 331.5K
+Contingency (20%)	$ 66.3K
GRAND TOTAL	**$ 397.8K**
MAINTENANCE	$ 1.0K/yr/location
X	16 locations
TOTAL	$ 16.0K/yr

C. Accountability Aid Phones

1. **Re-wiring Using Underground Conduit**

ITEM	COST
Construction/Wiring	$ 10.0K
Engineering Support	$ 2.0K
Drawings	$ 5.0K
SUBTOTAL	$ 17.0K/per location
X	10 Locations
TOTAL	$ 170.0K
ATP	$ 15.0K
SUBTOTAL 1	$ 185.0K
+Construction Management/Overhead(30%)	$ 55.5K
SUBTOTAL 2	$ 240.5K
+Contingency (20%)	$ 48.1K
GRAND TOTAL	**$ 288.6K**
MAINTENANCE	$ 1.5K/yr/location
X	10 Locations
TOTAL	$ 15.0K/yr

2. **IVDTS**

Per facility charges same as A2	$ 7.5K/per locations
X	10 Locations
Total	$ 75.0K
ATP	$ 15.0K
SUBTOTAL 1	$ 90.0K
+Construction Management/Overhead(30%)	$ 27.0K
SUBTOTAL 2	$ 117.0K
+Contingency (20%)	$ 23.4K
GRAND TOTAL	**$ 140.4K**
CIRCUIT FEES See *Note Under A2	
Initial	$ 105/mo per circuit
X	11 circuits
SUBTOTAL	$ 1.2K/mo
X	12/mo
TOTAL	$ 14.4K/yr
After billing arrangements	$ 30/mo per circuit
X	11 circuits
SUBTOTAL	$ 330/mo
X	12 mo
TOTAL	$ 3.9K/yr
MAINTENANCE	$ 500/yr/location

X	4 locations
TOTAL	$ 5.5K/yr

3. **Radio**

Equipment	$ 3.5K
Installation	$ 1.0K
Engineering Support	$ 0.5K
SUBTOTAL 1	$ 5.0K/per location
X	$ 11 Locations
SUBTOTAL 2	$ 55.0K
+Drawings	$ 5.0K
TOTAL	$ 60.0K
ATP	$ 15.0K
SUBTOTAL 3	$ 75.0K
+Construction Management/Overhead(30%)	$ 22.5K
SUBTOTAL 4	$ 97.5K
+Contingency (20%)	$ 19.5K
GRAND TOTAL	**$ 117.0K**
MAINTENANCE	$ 0.5K/yr/location
X	11 Locations
TOTAL	$ 5.5K/yr.

D. Payback Period

Payback period for each system was calculated using IVDTS and Radio Control. No payback was calculated using Re-wiring since no payback would exist given the higher total cost and maintenance cost.

PA ALARMS

1. Re-wire

GRAND TOTAL	$2180.1K
MAINTENANCE	$ 73.5/yr

2. IVDTS

TOTAL	$ 731.6K
CIRCUIT FEES	$ 52.8K 1st yr/15.6K/YR
MAINTENANCE	$ 49.0K/YR

3. Radio

GRAND TOTAL	$ 949.3K
MAINTENANCE	$ 36.0K/YR

Payback between IVDTS and Radio Control

731.6K + (52.8K/yr x 1 yr) + (15.6K/yr x (N - 1) yrs) + (49K/yr x N yrs) = 949.3K + (36K/yr x N yrs)

X	4 locations
TOTAL	$ 5.5K/yr

3. **Radio**

Equipment	$ 3.5K
Installation	$ 1.0K
Engineering Support	$ 0.5K
SUBTOTAL 1	$ 5.0K/per location
X	$ 11 Locations
SUBTOTAL 2	$ 55.0K
+Drawings	$ 5.0K
TOTAL	$ 60.0K
ATP	$ 15.0K
SUBTOTAL 3	$ 75.0K
+Construction Management/Overhead(30%)	$ 22.5K
SUBTOTAL 4	$ 97.5K
+Contingency (20%)	$ 19.5K
GRAND TOTAL	**$ 117.0K**
MAINTENANCE	$ 0.5K/yr/location
X	11 Locations
TOTAL	$ 5.5K/yr.

D. Payback Period

Payback period for each system was calculated using IVDTS and Radio Control. No payback was calculated using Re-wiring since no payback would exist given the higher total cost and maintenance cost.

PA ALARMS

1. Re-wire

GRAND TOTAL	$2180.1K
MAINTENANCE	$ 73.5/yr

2. IVDTS

TOTAL	$ 731.6K
CIRCUIT FEES	$ 52.8K 1st yr/15.6K/YR
MAINTENANCE	$ 49.0K/YR

3. Radio

GRAND TOTAL	$ 949.3K
MAINTENANCE	$ 36.0K/YR

Payback between IVDTS and Radio Control

731.6K + (52.8K/yr x 1 yr) + (15.6K/yr x (N - 1) yrs) + (49K/yr x N yrs) = 949.3K + (36K/yr x N yrs)

768.8 + 64.6N = 949.3 + 36N
28.6N = 180.5
N = 6.3 yrs

384 Powerhouse Annunciator Panel

1. Re-wire

GRAND TOTAL	$ 772.2K
MAINTENANCE	25.0K/yr

2. IVDTS

GRAND TOTAL	$ 210.6K
CIRCUIT FEES	$ 19.2K 1st yr/5.4K/yr
MAINTENANCE	16.0K/yr

3. RADIO CONTROL

GRAND TOTAL	$ 397.8K
MAINTENANCE	16.0K/yr

Payback between IVDTS and Radio Control

210.6k + (19.2K/yr x 1 yr) + (5.4K/yr x (N-1) yrs) +
(16K/yr x N yr) = 397.8K + (16K/yr X N yrs)

224.4 + 21.4N = 397.8 + 16N
5.4N = 173.4
N = 32 yrs

Accountability Aid Phones

1. Re-wire

GRAND TOTAL	$ 288.6K
MAINTENANCE	$ 15.0K/yr

2. IVDTS

GRAND TOTAL	$ 140.4K
CIRCUIT FEES	$ 14.4K 1st yr/3.9K/yr
MAINTENANCE	$ 5.5K/yr

3. Radio Control

GRAND TOTAL	$ 117.0K
MAINTENANCE	$ 5.5K/yr

No payback calculated between IVDTS and Radio Control given the closeness of the estimates.

APPENDIX C - ACOUSTIC TEST RESULTS

On Saturday June 18, 1994, an acoustic test was conducted in the 300 Area to determine coverage of external sirens. This test was conducted to see if the proposed external sirens would be able to penetrate and provide alarm warning to buildings with existing internal alarms. Of the 42 buildings with internal alarms, only 17 were chosen to be tested. In addition, two other facilities were also tested since it was requested by Emergency Preparedness that any siren upgrade include these facilities. The 19 facilities tested are listed below:

331, 350, 313, 333, 306, 314, 3719, 3717B, 3763, 3708, 303C, 335, 309, 323, 3745, 3707C, 3707D, 3760, 337 (Office Side)

These facilities were chosen for testing after consultation with 300 Area building managers from WHC and PNL as well as Emergency Preparedness representatives. The other facilities with existing internal alarms were determined necessary regardless of the external system and so were not tested. Of the 19 facilities tested, nine were able to clearly hear either the external tone or PA announcement or both. These nine facilities, then, were determined not to require upgrade of their internal systems if the external system is revised. The nine facilities are listed below:

331, 313, 333, 314, 3717B, 3763, 335, 309, 337

Hanford Plant Standard number HPS-359-E "Standard Specification For Emergency Audible Alarm Signals" provides for sound levels of alarms to be at least 10 dB above background at any point in the area covered. Of the listed nine facilities only three did not meet this criteria. They were 333, 3717B, and 309. However, the test was conducted with only two external sirens and one of these had only eight speakers while the other had ten. The proposed system will consist of three external alarms. Two will have ten speakers and one will have five speakers. The addition of this third external siren is expected to more than compensate for the required decibel levels not achieved at these three facilities. For complete test procedure and results see Electrical Power Systems Engineering Task Specification File number EPS-FY94-022.