



OVERHEAD TO UNDERGROUND UTILITY CONVERSION

CITY OF URBANA
PUBLIC WORKS
DEPARTMENT
706 SOUTH GLOVER
AVENUE
URBANA, ILLINOIS 61802

Date: 11/30/01



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1.0) INTRODUCTION

Recent changes in the Illinois Power tree trimming policies have many Urbana residents concerned over potential damage these policies may have on their trees. The tree trimming policies along with aesthetic issues prompted many Urbana residents to inquire about the feasibility of converting existing overhead utilities to underground facilities. Converting overhead utilities would mitigate those concerns. Under the direction of the Urbana City Council, the Urbana Public Works Department conducted a pilot study that examined the feasibility of converting overhead electric, telephone and cable utility services to underground services. The pilot study was performed in southwest Urbana on the block bounded by Washington Street to the north, Iowa Street to the south, Busey Avenue to the west and Orchard Street to the east. Attachment #1 indicates the boundary of the pilot study. The study area represents a typical block where neighborhood residents may have an interest in converting overhead utilities to underground utilities.

The primary goal of converting existing overhead utility services to underground services is the elimination of the conflict that exists between the trees and utility lines. The utility companies and homeowners have differing viewpoints as to the best approach for dealing with the conflict that exists between the trees and the utility lines. From the utility company standpoint, trees that are adjacent to utility lines have the potential to damage utility services and cause utility outages. In order to prevent damage to the utilities, many utility companies have elected to manage tree growth through selective trimming of the trees within their easements or City right-of-way. Illinois Power is one such utility company that feels it is in their long-term interest to keep their overhead facilities in tact while maintaining a dedicated tree-trimming budget that is utilized to manage tree growth around their utility lines. However, from the homeowner's standpoint, the tree trimming policies represent a danger to the health of the trees and they would prefer a conversion of the overhead utilities to underground utilities. See Attachment #2 for a photograph of an overhead utility system located in the backyards of a subdivision.

Upon initial examination, a conversion of overhead to underground utilities seems to be the ideal solution since it answers the concerns of both the utility companies and the homeowners. A conversion of the existing overhead utility facilities to underground facilities

would eliminate the tree management concerns of the utility companies and the tree damage concerns of the homeowners. However, the viewpoints of the utility companies and homeowners diverge when installation and cost issues are factored into the problem. Installation and cost issues form the basis of the overhead to underground conversion policies adopted by the utility companies. Illinois Power has examined the conversion of existing overhead utilities to underground utilities. The conclusion drawn by Illinois Power during their examination is that it is in their financial interest to keep their facilities overhead and trim the trees.

The installation issues that complicate the conversion of overhead utilities to underground facilities include items such as 1) shorter design life of the underground system, 2) maintenance and repair accessibility of the underground facilities, 3) above ground hardware issues and 4) the conversion of household wiring to accommodate underground services.

Perhaps the most important factor that requires consideration is the cost responsibility associated with the conversion of overhead to underground utility services. Many residents may not know or understand that a significant cost is required to convert the utility systems to underground facilities. Some of these costs include 1) non-recoverable costs such as unused life in the existing system and removing existing facilities, 2) new installation costs as well as 3) the costs required to re-wire each home to accommodate the underground utilities. The utility companies expect the residents in the conversion area to pay for all of these costs. As part of this study, each utility company provided a cost estimate to convert their respective utility from an overhead to an underground facility.

The overhead utilities that exist in the study area include electric, telephone and cable television facilities. While each of these utilities is an important part of the study, the electrical facilities provided by Illinois Power have become the focus of the most attention in the recent months. Because of this attention, the study focuses on the underground conversion of the electrical facilities with the understanding that similar issues face the conversion of telephone and cable television facilities.

Illinois Power, Ameritech and Insight Communications contributed to this study by providing the Urbana Public Works Department the installation information that was necessary to complete the study.

2.0) INSTALLATION AND ENGINEERING CONSIDERATIONS

While many of the installation and engineering considerations made by the utility companies are unique to each overhead to underground utility conversion, there are many other considerations that are generally taken into account on every project. Some of the installation and engineering considerations that are generally a part of every project include the 1) design life of the facilities, 2) accessibility issues that affect restoration time and 3) above ground hardware issues.

New residential subdivisions in Urbana and surrounding communities fit the model of a modern underground utility system. A new residential subdivision typically has directly buried electrical conductors, television and telephone cables in conjunction with above ground transformers, pedestals and other hardware cabinets. Illinois Power indicates that their main concern with this type of installation is the design life of the directly buried conductors. Specifically, the design life of a directly buried conductor is shorter than a similar overhead installation. According to Illinois Power, an underground directly buried conductor has a design life of 20 to 30 years, while an overhead conductor has a 40 to 70 year design life. The shorter design life of a directly buried conductor is attributed to cracking of the insulation due to age and damage caused by nearby lightning strikes. Illinois Power also indicates that placing conductors in a conduit does not significantly improve the design life of a buried conductor. Additional manholes and switch boxes are required if a conductor is placed inside a conduit.

Perhaps one of the most misleading aspects of an underground utility system is that all of the components are located underground. This is generally not the case, as most utility systems must have some components located above ground for maintenance and repair access. For example, an electrical utility system generally has transformers, pedestals, switch boxes, fuse cabinets and feeder power lines (4 kilovolt (KV) and 12 KV lines) located above ground. According to Illinois Power, it is possible to locate transformers, pedestal and switch boxes and fuse cabinets underground; however, repair technicians lose the flexibility to maintain and repair these components if they are located underground. In addition, an underground installation of these facilities is rarely implemented because of the high costs.

According to Illinois Power, the transformers and pedestals in an underground power utility system are typically located above ground in the front yards of a new residential

subdivision. In fact, Illinois Power policy requires the placement of transformers and pedestals in the front yards of new subdivisions. Transformers are generally located every 6 to 8 homes and pedestals are required for every other home. Transformers are typically a 4-foot by 4-foot metal cabinet. Pedestals are generally 15-inch in diameter and stand two feet above the ground. In addition, some side lots may require large fuse cabinets that measure 5-foot by 5-foot by 5-foot. See Attachment #3 and Attachment #4 for photographs of electrical transformers and pedestals. Transformers and pedestals are not typically placed underground in new residential subdivisions according to Illinois Power. Transformers, pedestals and fuse cabinets are required in any area that converts from overhead to underground utilities. See Attachment #1 for the general location of the utility transformers and pedestals in the study area.

In areas with existing overhead utilities, Illinois Power prefers to maintain their existing overhead utilities instead of converting them to underground utilities. Illinois Power gives several reasons for adopting this policy. First, replacing the existing overhead conductors with new overhead conductors would have a significantly longer design life than replacing them with underground conductors. As mentioned previously, an overhead conductor has a 40 to 70 year design life while a directly buried conductor has a 20 to 30 year design life. Second, linemen and repair technicians require less time to locate and repair defective overhead power lines than comparable underground power lines. Power restoration during outages may take several hours more in an underground system as opposed to an overhead system. In other words, overhead power lines give Illinois Power more flexibility to restore their facilities than equivalent underground facilities. Illinois Power has examined these issues and determined it is more cost-effective to keep their overhead facilities and perform selective tree trimming.

3.0) UNDERGROUND INSTALLATION IN THE STUDY AREA

As mentioned in the introduction, the pilot study was performed in southwest Urbana on the block bounded by Washington Street to the north, Iowa Street to the south, Busey Avenue to the west and Orchard Street to the east as indicated on Attachment #1. The study area profiles a 30 home neighborhood that would benefit from the conversion of existing overhead utilities to underground facilities. The existing overhead utility system is located in the backyards of the homes in the study area as shown on Attachment #2. As indicated in Attachment #2, the existing utility system consists of overhead electrical conductors, electrical transformers, poles, telephone and cable television wires.

As part of this study, Illinois Power, Ameritech and Insight Communications examined the feasibility of converting existing overhead electric, telephone and cable television utilities to underground utilities. Illinois Power was responsible for examining the conversion of electrical systems. Ameritech was responsible for examining the conversion of telephone systems. Insight Communications was responsible for examining cable television systems. The respective utility companies contributed their technical expertise at their own expense to examine the feasibility of an overhead to underground conversion.

The specific tasks involved in performing an overhead to underground conversion in the study area include 1) removing existing overhead electrical conductors and telephone/television cables, 2) removing existing poles and associated hardware, 3) installing new underground electrical, telephone and cable television distribution facilities, 4) installing new electrical transformers/pedestals, telephone and cable television pedestals, 5) installing new underground electrical service conductors and telephone/television service cables and 6) rewiring the inside of homes to accept the underground services. The overall consensus of the utility companies was that the specific tasks required as part of the conversion in the study area presented no major complications that would prevent the installation. A great deal of coordination would be required of the utility companies in order to accomplish the tasks involved in the conversion.

This study examined two alternatives, Alternative #1, which includes a full conversion of all the utilities and Alternative #2, which includes a partial conversion that involves relocating only the electrical facilities.

The utility companies require written agreements from all homeowners that indicate the homeowners want an underground system. All homeowners must provide written agreements before work begins on the conversion. The utility companies feel this is necessary in order to avoid installing, for example, an underground system for 90% of the block only to suddenly jump to an overhead system for homeowners who do want an underground system. The utility companies also require written utility easements at no charge from each resident in the area.

Residents in the area should expect disruptions to their yards and other landscape features during the course of the conversion. The utility companies estimate that between 4 and 10 weeks are required to complete their respective portion of the conversion.

The specific installation tasks for the electrical, telephone and cable television services are presented in the following sections.

3.1) Electrical Installation

Illinois Power points out that the study area is located electrically at the end of the line, which means that no multi-phase primary lines are present in the study area. Since the study area has no multi-phase primary lines, the installation involves only the overhead to underground conversion of local distribution conductors. It is important to note that an overhead to underground conversion of multi-phase primary lines presents a more difficult installation scenario than a conversion of local distribution facilities. Consequently, if a conversion of multi-phase primary lines were required in an area, the costs would dramatically increase over the costs of a conversion of local distribution facilities.

In order to complete the conversion in the study area, Illinois Power would remove the existing overhead conductors, transformers and poles and replace them with directly buried distribution conductors. If sidewalks, driveways, trees or other obstacles impede the direct burial operations, Illinois Power would utilize directional boring operations to install the conductors under such obstacles. Directional boring represents a deviation from Illinois Power's standard direct burial operation and would drive up the installation costs. The electrical distribution facilities would be located within easements in the front yards of the homes in the study area. Upon completion of the installation, the only visible portion of the electrical distribution system would be the transformer cabinets and the pedestals, as presented in Attachment #3 and

Attachment #4. A transformer cabinet would be required every 6 to 8 homes while a pedestal would be required at every other home.

Illinois Power generally trenches the first 100 feet of electric service wire (wire from the local distribution facilities to the home) to each residence at no additional charge. Electric service wires are normally trenched in the ground from the local distribution facilities to the meter location at the home. If obstructions such as trees, fences, driveways, shrubs, etc. do not allow a minimum 10 foot wide path for trenching, directional boring may be required to install the service wires. The homeowner would incur the additional cost required to directional bore the service wire. As an alternative to directional boring, Illinois Power indicates that the homeowner may install conduit to house the service wires.

Another installation issue that homeowners face is the reconfiguration of the service entrance at their home. The homeowner would be responsible for hiring an electrician to replace the existing overhead service entrance to accommodate the underground service wire. Some homes may have to relocate the entire service entrance if decks, patios, walks, etc. conflict with the alignment of the underground service wire.

Illinois Power would require access easements (at no cost) in the front yards of all homeowners in order to access and maintain their distribution facilities.

Illinois Power would coordinate the removal of the overhead facilities and the installation of the underground facilities so that electrical service is not interrupted during the conversion. Residents should allow approximately 4 weeks for Illinois Power to complete the conversion. Illinois Power may remove and reinstall landscape and yard features at some locations during the course of the underground utility conversion.

3.2) Telephone Installation

Ameritech would remove their existing overhead cables and replace them with underground distribution cables placed inside a two-inch diameter conduit. The components of the telephone installation include placing the distribution cable, installing the telephone service pedestals and trenching in the service cables from the pedestals to each home. Generally, a single telephone pedestal serves four homes, which means that a telephone pedestal would be required at the back corner of every other lot. The new underground distribution cable and

service pedestals would be located in homeowner's backyards. Residents should expect a certain amount of disruption to landscape and yard features during the removal and installation of the underground system.

Ameritech would trench each homeowner's service cable from the telephone pedestal to the existing service entrance located at each home. Depending on the existing service entrance configuration, some homes may require internal re-wiring in order to accept the underground service. Ameritech would perform the internal re-wiring in each home.

Ameritech will require utility easements from all residents in the area as part of the overhead to underground utility conversion.

When completed, the only visible components of the underground telephone system would be the pedestals located in the backyards. See Attachment #5 for an example of a telephone service pedestal.

Ameritech would coordinate the removal of the overhead facilities and the installation of the underground facilities so that telephone service is not interrupted during the conversion. Residents should allow approximately 8 to 10 weeks for Ameritech to complete the conversion.

3.3) Cable Television Installation

Insight Communications would remove their existing overhead television cables and replace them with directly buried underground cables. The components of the cable television underground conversion include trenching in the distribution cable, installing the cable service pedestals and trenching the cable services from the pedestals to each home. Insight Communications would utilize the backyards of homeowners as the location for their distribution cable and service pedestals. Cable pedestals would be placed at the back corner of a lot with a spacing of every other lot. A cable television pedestal placed at such a location would serve approximately four households. Attachment # 6 shows an example of a cable television pedestal. As with the electric underground conversion, residents should allow approximately 4 weeks for the installation of the underground cable television service.

In certain homes, the service entrance may require reconfiguration in order for the home to accept the new underground service cable.

The only visible portion of the completed underground cable television system would be the service pedestals.

3.4) Alternative #1

Alternative #1 includes removing all existing overhead electrical, telephone and cable television facilities and replacing them with underground facilities. Illinois Power, Ameritech and Insight Communications would remove their respective overhead utilities and place them underground as indicated in the previous sections.

This alternative is the more costly of the two alternatives, however, Alternative #1 also has the most benefits to the subdivision. Alternative #1 would completely eliminate all of the overhead utility systems. The tree trimming concerns and the aesthetic issues of the overhead utilities are completely eliminated with Alternative #1.

Alternative #1 may require more utility poles and power lines in the area adjacent to the study area. The addition of poles and lines in the adjacent area may be necessary in order to provide adequate feeds to the new underground facilities or to adjacent overhead areas.

3.5) Alternative #2

Alternative #2 involves Illinois Power converting their overhead facilities to underground facilities while Ameritech and Insight Communications maintain their existing overhead facilities. Under this alternative, the telephone and cable television wires would remain overhead at the present location in the rear lots. Consequently, the residents would not incur any costs associated with an overhead to underground conversion of telephone or cable television facilities. Residents would still incur the costs of an overhead to underground conversion of electrical facilities. Since Illinois Power currently owns the existing poles, a transfer of pole ownership from Illinois Power to Ameritech is required if Illinois Power performs the overhead to underground conversion by itself. A cost of approximately \$2,000 is required to transfer pole ownership from Illinois Power to Ameritech. Ameritech expects the residents to reimburse them for the pole transfer costs.

This alternative would eliminate the tree trimming concerns around electrical lines. However, the utility poles with telephone and cable wires would remain in the rear lots of the subdivision. Ameritech and Insight Communications have no formal tree trimming or tree removal programs. Ameritech and Insight Communications only trim trees if there is physical contact with the cables. Ameritech indicates that they have performed tree trimming on a very limited basis over the last 20 years.

4.0) COSTS AND RESPONSIBILITY FOR THE REMOVAL AND INSTALLATION

In order to complete the project, each utility company must remove their existing overhead systems and replace them with new underground systems. In the 30 home study area, a significant cost exists to convert existing overhead facilities to underground facilities. The utility companies expect the residents in the area to pay the entire cost for the conversion before proceeding with any work. The costs associated with such a conversion include 1) the costs incurred by the utility companies to remove and replace their distribution facilities, 2) the service run costs, 3) the service entrance reconfiguration costs and 4) in house re-wiring cost required to accept the underground utility. This section of the study outlines the costs associated with the overhead to underground conversion in the study area. All costs included in this section are approximate and based on the costs in effect at the time of the estimates. The actual costs involved with any alternative are unknown until the final design of the alternative.

Table 1 outlines the cost to implement Alternative #1, which includes removing and installing electrical, telephone and cable television service in the study area:

| SOURCE OF COSTS | APPROXIMATE COSTS |
|--|--------------------------|
| Illinois Power Electric Conversion | \$42,000 |
| Additional Electrical Service Boring Costs (Est. avg. of 50 l.f. @ \$14.00/l.f. per home) | \$21,000 |
| Homeowner’s Cost To Reconfigure Electrical Service Entrance At 30 Households. Each Homeowner Hires An Electrician Estimated At \$1,000 Per Home. | \$30,000 |
| Ameritech Telephone Conversion | \$66,000 |
| Insight Communications Cable T.V. Conversion | \$16,000 |
| Subtotal | \$175,000 |
| Contingency @ 20% of subtotal | \$35,000 |
| Total Cost Alternative #1 | \$ 210,000 |

TABLE 1

Costs for Alternative #1: Complete Overhead to Underground Conversion

Based on the costs included in Table 1, each homeowner can expect to pay at least \$7,000 in order to receive underground utility services. Additional costs may be required from certain homeowners if additional directional boring or in-home rewiring is required to install their service wires. The basis of the additional costs is outlined in the next sections.

4.1) Underground Electrical Installation Cost

The \$42,000 estimate provided by Illinois Power includes 1) \$6,500 for the non-recoverable costs of installing and removing existing facilities, 2) \$12,500 to install the new underground distribution facilities and 3) \$23,000 for the excess cost of boring distribution facilities in locations where trenching is not possible due to obstructions.

The non-recoverable costs account for the unused life and removal of the existing distribution facilities. Under the non-recoverable costs, residents get credit for the depreciation of the existing facilities. The non-recoverable cost was determined by estimating the current cost to install and remove the existing facilities and multiplying that cost by a depreciation value of 12%.

Illinois Power generally trenches the first 100 feet of service wire to each household at no additional cost to the homeowners. This cost has been included in the \$42,000. However, under some circumstances homeowners can expect to pay an additional amount for Illinois Power to provide their service wire. First, homeowners are expected to pay for any service wire in excess of 100 feet. Illinois Power estimates that service wire in excess of 100 feet costs about \$6.90 per linear foot, which includes filling in the trenches and seeding disturbed areas. Second, if trenching obstructions such as trees, fences, sidewalks, etc. exist along the service wire path, Illinois Power would directional bore the service wire. Homeowners are expected to pay for the additional cost required to directional bore the service wire. The excess cost of directional boring a service wire is estimated at approximately \$14.00 per linear foot.

Illinois Power estimates that 29 of the 30 homes in the study area will require reconfiguration of their service entrances. Homeowners must hire an electrician to perform the reconfiguration of their service entrance at an approximate cost of \$1,000 per household. For the purpose of the study, 30 homes have been assumed to require reconfiguration of their service entrance.

Attachment #7 outlines the costs provided by Illinois Power to complete the overhead to underground electric conversion in the study area.

4.2) Underground Telephone Installation Costs

The \$66,000 estimate provided by Ameritech Telephone Company accounts for all of the costs associated with the removal of existing overhead telephone facilities and the installation of new underground facilities up to each home. Included in the \$66,000 is the cost for installing the service cables from the pedestals to each household. Some homes may require re-wiring in order to accept the new underground services. The cost for in-home rewiring was not included in the \$66,000 estimate. However, the 20% contingency accounts for the cost required to rewire each home.

Attachment #8 outlines the costs provided by Ameritech to complete the overhead to underground conversion of telephone service in the study area.

4.3) Underground Cable Television Installation Costs

The \$16,000 estimate provided by Insight Communications accounts for all of the costs associated with the removal of existing overhead cable television facilities and the installation of new underground facilities. Included in the \$16,000 is the cost for installing the service cables from the pedestals to each household. Attachment #9 outlines the costs provided by Insight Communications to complete the overhead to underground conversion of cable television in the study area.

4.4) Underground Electrical Conversion Without Telephone or Cable

Significant cost saving are possible if Illinois Power converts their overhead facilities to underground facilities while Ameritech and Insight Communications maintain their existing overhead facilities (Alternative #2). Under Alternative #2, the telephone and cable television wires would remain overhead at their present location. Consequently, the residents would not

incur any costs associated with an overhead to underground conversion of telephone or cable television facilities. The costs required to implement Alternative #2 are summarized in Table 2.

| SOURCE OF COSTS | APPROXIMATE COSTS |
|--|--------------------------|
| Illinois Power Electric Conversion | \$ 42,000 |
| Additional Electrical Service Boring Costs (Est. avg. of 50 l.f. @ \$14.00/l.f. per home) | \$21,000 |
| Homeowner's Cost To Reconfigure Electrical Service Entrance At 30 Households. Each Homeowner Hires An Electrician Estimated At \$1,000 Per Home. | \$30,000 |
| Ameritech Telephone Pole Ownership Transfer Cost | \$ 2,000 |
| Subtotal | \$95,000 |
| Contingency @ 20% of subtotal | \$19,000 |
| Total Cost Alternative #2 | \$ 114,000 |

TABLE 2

Costs for Alternative #2: Overhead to Underground Electrical Conversion Only

As mentioned early, Illinois Power currently owns the existing poles. A transfer of pole ownership from Illinois Power to Ameritech is required if Illinois Power performs the overhead to underground conversion by itself. A cost of \$2,000 has been included in Table 2 to account for the transfer of pole ownership from Illinois Power to Ameritech.

Under this alternative, each household can expect to pay at least \$3,800 to receive underground electrical service. Telephone and Cable television service would remain overhead at the present location.

5.0) CONCLUSION

The study indicates that the utility companies feel the overhead to underground conversion is a feasible alternative to meet the goals of eliminating the overhead utility and tree conflict. However, an overhead to underground conversion has a significant cost that the homeowners must pay in order to achieve their objectives. These costs are estimated to be at least \$7,000 per household for Alternative #1, which includes a full conversion of all utilities. Some residents may incur additional costs beyond the \$7,000 because of in home re-wiring issues and additional trenching or boring requirements. Homeowners could elect Alternative #2, which includes the conversion of the electrical facilities while maintaining the overhead telephone and cable television utilities. Homeowners should expect to pay at least \$3,800 to implement Alternative #2. Any possible City of Urbana contribution toward a conversion is not factored into the costs to homeowners. In addition, there are no known grants available for this work.

There must be a consensus of all homeowners in an area before work begins on a project. The project could fail if even one homeowner has no interest in participating. Therefore, it is important to have all homeowners involved from the start in order to determine the amount of support for a project.

Homeowners must keep in mind that the installation of an underground utility system will cause temporary modifications and disruptions to their yards, fences, gardens, shrubs and other features.

Some homeowners may have to hire electricians in order to reconfigure their electrical service entrances to accommodate the underground electric services. In additions, some homes may require re-wiring in order to accommodate telephone and cable television services.

ATTACHMENTS



Attachment #2: Photograph of existing overhead utilities.



Attachment #3: Photograph of an electrical transformer cabinet.



Attachment #4: Photograph of electrical pedestal.



Attachment #5: Photograph of a telephone pedestal.



Attachment #6: Photograph of a cable, telephone and electrical pedestal.
Cable pedestal shown on the far left.