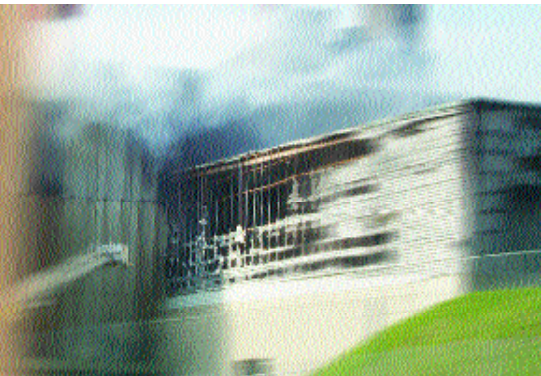


by Robert H. Brickner



Old bricks, new build

A reuse and recycling project brings down the house

Demolition of buildings generates waste concrete, metals and other materials on order of tens and even hundreds of tonnes. This staggering amount of materials can be salvaged for future building works. For instance, the demolition of a waste-to-energy plant has achieved a 98.5% reuse and recycling rate – as well as significant cost savings.

On 23 May 2002, at approximately 8:45 pm, a fire broke out within the waste tipping floor at the Nashville Thermal Transfer Corporation (NTTC) waste-to-energy facility. The fire damage was extensive. The 15,000 square-foot (1400 m²) drive-through receiving building where trucks entered and discharged waste materials was totally destroyed. The waste-to-energy facility was originally scheduled for closure in late September 2002. But the fire the night of 23 May became the 'line in the sand' for the NTTC's rapid phase-out as a waste-to-energy system and for its ultimate demolition.

Nashville Thermal Transfer Corporation was chartered in 1970 to provide district heating and/or cooling services to 38 buildings in downtown Nashville, Tennessee. Operating for almost 30 years as a waste-to-energy (WTE) system, the NTTC facility had the capacity to convert 1050 tons (953 tonnes; 1 tonne = 1.1023 US short ton) of solid waste into energy each day, producing 250,000 pounds (11,000 kg) of steam per hour using three waste boilers/incinerators, two natural-gas-fired back-up boilers, and four chillers to produce chilled water for district cooling.

Metropolitan Nashville and Davidson County (Metro) participated in NTTC under a funding agreement, which included setting rates for energy and solid waste disposal. Metro made an initial budget and supplemented it, as necessary, to meet its financial obligations to NTTC (see Table 1). Because of a significant supplemental request made by NTTC to Metro in fiscal year 2000, Metro decided to look into the operations and cost of NTTC relative to other options. Since the start of operation in FY 1975, the Metro funding amount had aggregated to approximately US\$110 million, and escalated considerably since 2000.

A comprehensive study began in July 2000 to review Metro's solid waste management system, which included NTTC's solid waste incinerator as Metro's primary disposal means.

TABLE 1. Fees paid by Metro to NTTC

Fiscal year	Amount (US\$ million)
1975	0.05
1980	1.3
1985	2.5
1990	2.7
1995	5.0
2000	7.8
2001	11.6
2002	14.5

Political decision-making – ‘Clean, Green and Lean’

Shortly after taking office in 2000, Bill Purcell commissioned a study that evaluated Metro’s solid waste management system. This study, conducted by Gershman, Brickner & Bratton, Inc. (GBB) of Fairfax, Virginia, found the district energy system in sound shape and providing a valuable service to its customers; however, from an economic and risk-assessment standpoint, the system could not continue to be fuelled by solid waste. The cost of disposal at NTTC was high and the plant’s operations were unreliable. Consequently, the Mayor recommended – and the Council approved – the ‘Clean, Green, Lean’ Waste Management Plan, which provided for greater waste diversion and recycling programmes for the city and a new, privately operated and performance-guaranteed district energy system.

As part of the new plan, Metro decided to phase out NTTC as a waste disposal option in three to five years, to enter into long-term contracts for the disposal of waste,

Site and facility before the dismantlement. PHOTO: M. MCCOY



and to change the district energy plant to a natural gas-fired system.

An uncontrollable circumstance: fire within the WTE pit

The remains of the NTTC’s steel tipping building were removed in about three weeks after the fire. Due to the buckling and falling of several of the high concrete building shell panels during the intense heat of the fire, all of the upper concrete panels had to be removed for safety purposes.

In all, over 7000 tons of waste materials were removed from the tipping floor and the WTE pit. The demolition of the tipping building generated over 85 tons of scrap metals, which were recycled. The waste burned on 23 May was the last at NTTC, as the three overhead cranes used to load the waste were destroyed beyond repair.

The fire also expedited the NTTC’s transition from using solid waste-derived energy to more conventional fossil

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fuels. Two package boilers were added to the NTTC and were used in concert with the original natural gas units for the next two years until the new Metro Energy Generating Facility started operations.

Demolition of buildings for the new Energy Generating Facility

The new Metro Energy Generating Facility (EGF), which was awarded to Constellation Energy Source Inc. of Baltimore, Maryland, was a major construction contract located directly to the south of the WTE plant. The development of the district energy system and a new bridge nearby required the ultimate demolition and site-related cleanup of a total of six buildings. Five of the six buildings designated for demolition fell within the scope of the Tennessee Department of Transportation’s (TDOT) Gateway Bridge Project, and one other building was within the Metro District Energy System (DES).

GBB issued a request for proposal (RFP) and proposals were accepted in June 2002. There were three possible methodologies and minimum estimated project costs for the demolition effort:

Traditional demolition – with limited salvage, as determined to be economically viable by the proposing party; \$957,750

Selected demolition – with the on-site inerts (such as concrete, block, brick, asphalt, dirt and rocks) segregated from



ABOVE Thermal plant still smoldering **BELOW** Preparation of fill material to eliminate metal contamination

the non-inert materials at the work zone, and processed into 'fill material' by a methodology deemed appropriate by the demolition contractor; \$899,000

Optimum material segregation and salvage – the same work as in 'selected demolition', except that the red brick facades would be peeled from all of the buildings, cleaned of all mortar and any other disfigurements, and organized,

The project was unique in achieving the combination of 'least costs' and 'high reuse/recycling'

stockpiled and wrapped on pallets for future use on-site as part of a new construction project; \$1,069,000.



The 'selective demolition' process, in which inerts are processed for use as fill material during subsequent construction, was the least expensive option. It was approximately \$60,000 (or 6%) less expensive than traditional demolition, in which all of the demolished materials (exclusive of salvaged metals) would be hauled to a disposal site.

From the demolition of the five largest buildings that were integral to the new DES site, a total of 12,400 cubic yards (9480 m³) of fill materials would be generated, including from the buildings' foundations. At an established value of \$9 per cubic yard (\$1.3/m³) of fill material, keeping the demolition material on-site and having it crushed to meet specifications saved Metro an estimated \$111,600.

Additionally, the projects generated approximately 122.5 tons of concrete reinforcing bar (rebar) and 254 tons of scrap metal. All of this metal was recycled. GBB estimated that at least 80% of the weight of materials within the largest buildings was reused as fill material at the DES or the contiguous Gateway Bridge site, or was recovered as scrap metal. The total avoided cost savings by recycling was estimated at \$200,000.

Full thermal WTE plant dismantling process

The final and largest effort of Metro's activity was the ultimate demolition of the remaining and all associated structures. The entire work zone encompassed 10 acres (4 hectares).

The project was unique in the blend of knowledge from both local and national consultant teams who were creatively working to achieve the combination of 'least costs' and 'high reuse/recycling'. It also tapped into the internet to expand awareness and the financial benefit of auctioning reusable NTTC equipment. The 'major' dismantlement project activities that were completed included:

- auctions of old equipment using Metro's eBid internet site
- asbestos removal from NTTC's heating and chiller plants
- additional fencing to secure the entire NTTC site
- removal of underground storage tanks
- complete demolition and full-scale reuse/recycling of the rest of thermal structures and materials used in the original construction
- placement of final cover soil and grass seeding on site.

More than 150 items, including both fixed and mobile equipment from NTTC, were purchased from the Nashville.gov

TABLE 2. Demo summary – material movement and reuse/recycling rate (final amounts as of November 2004 closeout)

Activity/item	Weight (tons)
Auction (recycled/reused)	1093
Demo steel, including rebar and structural steel	4394
Crushed concrete aggregate produced	50,007
Demolition debris to landfill *	983
Asbestos (removed/disposed at landfill)	21
Scrapped metal from auction and USTs	118
Railroad ties	7
Crushed asphalt produced	9747
Total weight of all materials	66,370
% recycled/reused (of total 65,366 tons)	98.5%

* Based on 600 pounds per cubic yard (~ 356 kg/m³) of volume removed

E-bid website, with over \$980,000 paid to Metro for these salvage rights. Most importantly, each sale required the winning bidder to remove the equipment from the work zone, thus lowering the scope and cost of the ultimate demolition contractor.

Metro provided markets for the inert recycled material. This included a portion of Metro’s former Ash Monofill disposal site (in the process of being capped) for the crushed, aggregated fill material. The integration and scheduling of

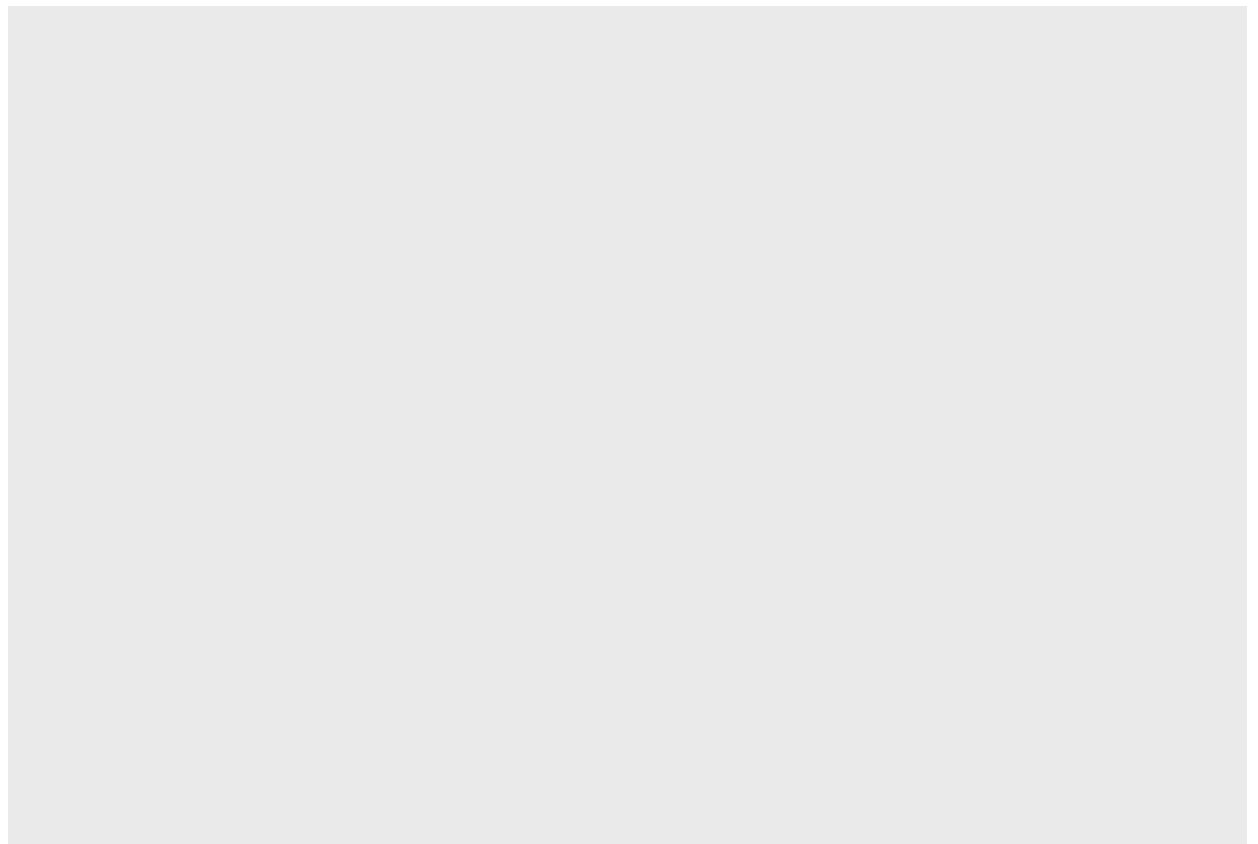
these different projects and the removal of all on-site tanks, fuels, contaminated soils and asbestos made the final work scope of the major demolition contractor very environmentally friendly, as there were less responsibilities where environmental risk might occur.

The 199-foot-tall (61-metre) concrete stack was removed using explosives. This major public spectacle, the first in the City of Nashville since 1972, was completed in July 2004. In addition, the Underground Storage Tanks (USTs) Removal Project removed three 40,000-gallon (151,420-litre) underground storage tanks associated with contaminated soil at the existing NTTC facility.

GBB wrote into the demolition contractor RFP that a concrete and asphalt crusher be brought onto the site to produce ‘fill material.’ As the crusher system produced product, the area previously housing the WTE pit provided a natural grade differential to stockpile the material. Hundreds of dump trucks were eventually loaded with

The net cost of the new build project was only \$115,000 compared with the \$2.4 million initial budget

crushed asphalt and crushed aggregate, which were transferred off the NTTC site to Metro markets, including the Metro Recycling Center and the Metro Ash Monofill. In



addition to concrete, the entire asphalt pavement at the project site was also excavated, ground and recycled.

The dismantlement timeline ran from the start of the auction process through the end of the final demolition contractor process. Over this period, all the key events taking place at the project site were documented. Over 66,000 tons of materials were tracked within eight categories (Table 2). As summarized, 98.5% of the total weight managed during the entire dismantlement process was either reused or recycled.

In 2000 the budget established for the contractor(s) of this planned project was estimated at \$2.4 million. It was presumed that one demolition contractor would handle the entire project, and the budget thus included mark-ups of subcontractors and other risk-related costs. But as the new DES development effort was taking place, interest in some of the older – and soon to be abandoned – energy equipment was being expressed. Thus the project took on a new direction, and with the success with the first equipment sales over the internet, there was no looking back.

The primary contractors' costs through closeout in late 2004 were \$1.1 million (see Table 3). Most important was the significant revenue input of Internet Auction Equipment Sale, which provided \$983,000. With revenues from the reuse auctions, high steel prices, and making use of the crushed aggregate and asphalt on other Metro projects, the net cost was only \$115,000 compared with the \$2.4 million initial budget.

TABLE 3. Overall project costs

Original demolition contractor estimate at 2000	\$2,400,000
Final project costs at 2004	
Underground storage tank removal	\$128,000
Asbestos removal	\$86,000
Install sections of new fencing	\$13,000
Dismantlement contractor	\$775,000
Cover dirt and seeding	\$96,000
Total cost of outside contractors	\$1,098,000
Internet auction (mostly in 2003)	(\$983,000)
Actual net total cost	\$115,000

The entire dismantlement and the return of the NTTC site to the property elevations not seen since the late 1960s took approximately 18 months (including the major auction events). Once the final project accounting was completed, the NTTC dismantlement resulted in:

- 98.5% reuse/recycling rate – a new 'normal' goal for demolition projects
- well under the original budget of \$2.4 million in 2000 – the result was \$115,000 in 2004
- work accomplished in a friendly and environmentally acceptable manner
- NTTC site now 'clean, green, and lean' – just as the Mayor requested.



LEFT TO RIGHT Pre- and post-demolition

Lessons learned

No single event or contracted service is so unusual as to not be transferable to other projects. However, it is very important to have the political commitment to undertake

It is very important to allow guidance by knowledgeable professionals

the effort, and to allow guidance and management by knowledgeable professionals within the field. Applying the

process to the dismantlement and extensive reuse/recycling of obsolete public infrastructures – including old schools, water purification plants and sewage treatment plants – is a practical example.

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