

Keeping the noise down and the lights on



When residents near a London substation complained about the noisy transformers, National Grid Electricity Transmission faced a challenge: address the complaints without interrupting electricity supplies.

By Janine Dickinson

In 2013, complaints were received about a loud, intrusive humming noise affecting residents near Ealing electricity substation in west London, UK.

The Ealing substation supplies electricity to more than 200,000 homes. The site is operated jointly by National Grid Electricity Transmission (NGET) and Scottish and Southern Electricity Networks (SSEN).

Four supergrid transformers (SGTs) on the NGET site lower the electrical voltage from 275,000 volts down to 66,000 volts, while six network transformers on the SSEN site further lower the voltage for use in homes and businesses.

Under electrical stress, transformers produce a low frequency humming noise. Following the complaints, the local council's Environmental Health Officer deemed the

noise to be causing widespread public nuisance. NGET and SSEN were at risk of being served with a legal notice to abate the nuisance. This notice had the potential to shut the substation down – but NGET and SSEN still had a legal requirement to ensure the supply of electricity.

NGET and SSEN needed to develop a noise mitigation scheme to abate the nuisance while continuing to enable electricity to be supplied. The design of the scheme needed to consider the concerns of residents and to ensure a safe system of work on site.

The cost of replacing the transformers was estimated to be in excess of £40 million, making this option unviable.

We replaced the old teak doors of the transformer noise enclosures with acoustic doors, lined the enclosures with acoustic

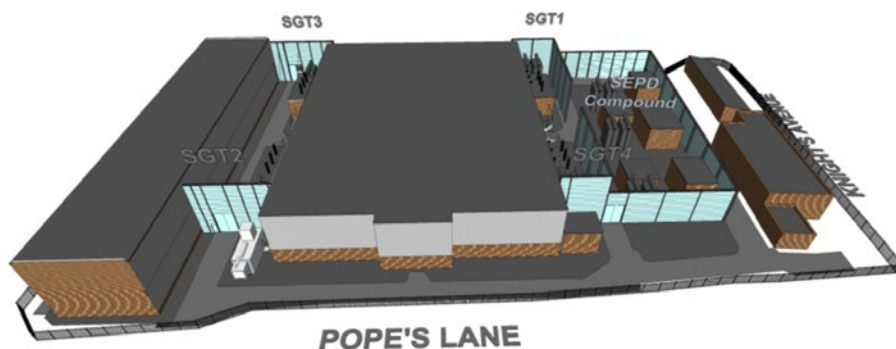
material and replaced the roofs. This improved noise levels off-site, but not to the standard we wanted. We needed additional measures to improve the community's peace and quiet.

We began a process of engagement with council officers, local councillors and residents to achieve a sustainable noise mitigation solution. The aim was to offer the best overall reduction in noise at multiple locations around the site, while balancing the visual impact on local residents.

Community consultation

We designed 13 different noise mitigation schemes and used acoustic modelling software to predict the level of noise reduction they would achieve at numerous locations around the site. The designs included various heights of noise barrier, along with glass and cantilevered sections to reduce the visual impact. The software showed that the most effective option was a 12-metre high acoustically absorptive barrier.

We consulted with the Local Authority's Planning Department. They advised that the mitigation scheme could be constructed under permitted development rights, so planning consent was not required. Obtaining planning consent requires rigorous scrutiny of plans and designs, as well as community input. Since planning consent was not required, our designs could potentially have gone unchecked and unchallenged. But as responsible



National Grid Electricity Transmission used artist's impressions like this to consult the community about the proposed scheme. Image credit: Markwick Architects

companies, focused on stakeholder engagement, we believed that input from the local community was necessary to ensure the solution was acceptable for all the affected parties.

So in 2014, using artist's impressions to demonstrate the proposed appearance of the barrier, including views from residents' homes, we sought feedback about our proposed designs, and asked residents to vote for their preferred colour.

NGET engaged the services of a public relations company to support engagement with the local community through regular meetings and letter drops. A temporary office was installed on the substation site for community meetings, to consult with residents, and to allow us to gain people's feedback during all phases of the development.

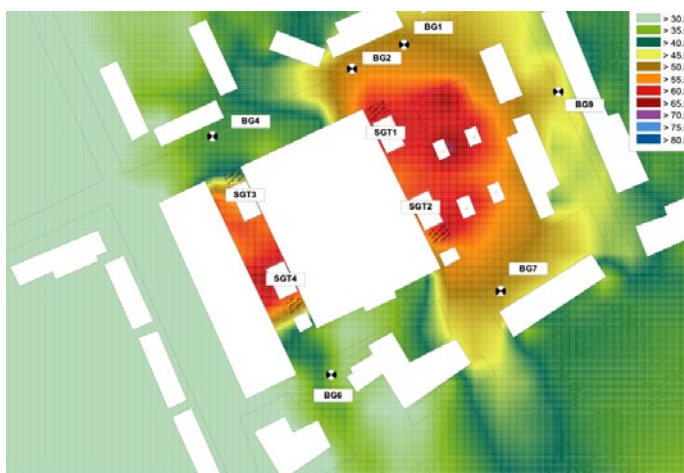
Based on the artist's impressions, concerns were raised about the height and visual impact of the barrier. We addressed these concerns by reducing the height to eight metres in the sections closest to people's houses. The barrier was designed so that the height could be increased in the future if noise complaints continued.

Blending in

A 12-metre high test barrier was erected so that council officers and NGET acoustic specialists could jointly assess its success at abating the nuisance before agreeing final design amendments. A key design change was necessary at this stage, to ensure there was enough air flow to cool NGET's transformers. These critical changes were made without affecting the acoustic performance of the barrier.

Following confirmation of the success of the trial barrier, the design for the whole site was finalised. This involved significant community consultation, and modification of the proposed designs in response to the community's feedback. Detailed acoustic modelling helped determine the effectiveness of the revised designs. Through ongoing community engagement, a design was finalised in 2017.

The final design was an acoustically absorptive barrier, 12 metres high around the NGET transformers, eight metres high around the SSEN transformers, and totalling 475 metres in length. Following long-term consultation with the local authority and residents, a graduated colour scheme was



agreed on, with tree transfers applied to the finished wall to improve the overall visual appearance.

To minimise disruption during the construction phase, which ran from July 2017 to December 2018, our public relations company supported our work with local residents to determine acceptable routes for construction traffic to take through the residential streets. We also installed temporary acoustic hoarding around the site to minimise disruption from operational and construction noise, as well as to reduce the visual impact of the construction work.

The confined nature of this inner-city site set many challenging technical problems to overcome. The site is surrounded and

Top image: Aerial view of the substation, highlighting the NGET site (large left-hand area) and SSEN site (smaller right-hand area). Image credit: Google Maps

Bottom image: A model of the site built with acoustic modelling software. Image credit: Xodus Group

infiltrated by a network of low and high voltage underground cables, concrete tunnels and overhead high voltage conductors of up to 275,000 volts. This required detailed risk assessments, method statements and lifting plans for crane operations to install structural steelwork up to 12 metres tall. A multidisciplinary team came together to tackle these challenges (see box).

We worked with the Environmental Health Officer to design a methodology for measuring the effectiveness of the barrier. Once construction was complete, we worked with the officer to monitor noise at various locations around the site in the early hours of the morning, in line with our agreed methodology.

The barrier has significantly reduced off-site noise in all locations. We compared the actual noise reduction against our acoustic consultant's original predictions, and found that the noise barrier had achieved and, in some locations, even outperformed the noise reduction levels predicted by the acoustic models.

As a result, complaints from the community about noise from the site have ceased. The community spokesperson provided very positive feedback on behalf of the local residents, writing to advise us that the barrier seems effective at reducing



Left: the substation's original brick walls. Right: after adding acoustically absorptive surfaces. Image credit: NGET

noise, especially for those living near the NGET transformers.

Positive feedback was also received from the Environmental Health Officer, and we no longer anticipate any further involvement from them in respect of the noise complaints.

Benefits of collaboration

Investigations by Environmental Health Officers often result in legal enforcement action. This leads to prolonged disturbance to residents as the nuisance continues to disturb the community while legal

proceedings take place, as well as leading to legal costs on both sides. By working closely with the officer and with local residents, we avoided the need for legal action, and with it, the prolonged disturbance to residents, the legal costs, and the potential of financial penalties and damage to our reputation.

The measurements from the site have validated our predictions and models. By quantifying the benefits we achieved against robust predictions, we were able to demonstrate that the financial investment in the scheme successfully delivered the expected value.

National Grid asked residents which colours, patterns or transfers they would like applied to the new structures. Image credit: Markwick Architects



Through careful design, we ensured the operational safety and efficiency of the transformers throughout the installation of the noise mitigation scheme.

In 2018, the scheme received the John Connell Noise Abatement Society Award, which recognises shining examples of community cooperation, education and creative solutions to noise pollution problems. The project was shortlisted for the Customer Service Award at the IAM Global Awards 2019. And the scheme has also won the Institute of Acoustics Sustainable Design Award for 2020, which recognises solutions that balance reducing unwanted noise with minimising other environmental and community impacts.

We were also invited to showcase the project at a UK Acoustics Network Soundscape conference in London, as an example of best practice.

Working on the scheme has greatly improved our relationship with the community around the substation. They are now more accepting and understanding of the substation site, and we have developed a better understanding of their needs. By keeping residents informed, giving them a voice, and making their views key to the design of the scheme, we built trust and enhanced National Grid's reputation with the community.

The community spokesperson thanked the whole team for our efforts to deliver the project, and in particular for the exemplary engagement we developed with the residents – an effort they greatly appreciated. The spokesperson said that the project has been an important collaborative achievement for the whole neighbourhood.

Communal effort

A large multidisciplinary project team came together to deliver a successful outcome.

- NGET's in-house experts provided acoustic support throughout the project. They measured noise during the day and in the middle of the night, and provided other team members with advice about the acoustic benefits of each design option.
- The engineers responsible for the day-to-day management of the site provided electrical engineering support, ensuring continuity of electricity supplies, as well as safety on site.
- Civil engineers provided input into the design specifications for the final build.
- Our investment team produced the business case to obtain funding for the development from NGET and SSEN, and our senior management team sanctioned the significant investment required.
- We brought in expert acoustics consultants from outside NGET and SSEN to create detailed models of how noise propagates from the site, and to model the effects of replacing the roofs on the NGET enclosures and of the 13 proposed noise mitigation schemes.
- We engaged a project management team that specialised in delivering construction projects on electrical infrastructure sites, to oversee and deliver the construction phase.
- Local residents provided feedback throughout the project, mostly via a spokesperson appointed by the community.
- Local councillors and the Member of Parliament for the area liaised between affected residents and National Grid.
- The council's Environmental Health Officer was involved from the start, when they assessed the noise to be causing a Statutory Noise Nuisance under the Environmental Protection Act 1990, and remained involved in noise monitoring in collaboration with National Grid's noise specialists.
- SSEN was involved in communication throughout the project, and contributed to the cost of the solution.



Image credit: Markwick Architects

About the author



Janine Dickinson is a Senior Environmental Engineer at National Grid Electricity Transmission. She has over 15 years'

experience in the field of acoustics across both the public and private sectors and is a Corporate Member of the Institute of Acoustics (MIOA). Janine joined National Grid in 2012, where she specialises in assessing and managing operational noise from electricity transmission assets.

NGET offers [acoustic consultancy support](#) across of a range of industries.