CE Electric UK

# 2004/05 IFI Annual Report

August 2005

# Contents

# 2004/05 IFI annual report

August 2005

## Executive summary

1. This paper has been prepared by CE Electric UK Funding Company Ltd (CE) to inform interested parties of the activities of its licensees, Yorkshire Electricity Distribution plc (YEDL) and Northern Electric Distribution Ltd (NEDL), on innovation. It has been prepared in accordance with the regulatory instructions and guidance (RIGs) and the Energy Networks Association (ENA) Engineering Recommendation (ER) G85 (the Good Practice Guide).
2. The reporting period (the six months ending 31 March 2005) has necessarily been characterised by a slow build-up, as we establish the governance arrangements required for effective use of consumers' funds. Productive work has been dominated by existing structures such as:
   - the EA Technology Limited (EATL) Strategic Technology Programme (STP); and
   - the Energy Networks Association (ENA).
3. The key additional project for CE is for a novel specification to replace Woodhouse steel girder mast overhead lines.
4. Qualifying spend for the period has been £39,800 and £59,800 for NEDL and YEDL respectively, of which £6,000 and £9,000 relates to internal costs.
5. There is a delicate balance we need to resolve in taking work forward, between either:
   - exploiting the ENA and EATL STP frameworks, where the need for consensus extends the process but collaborative specification and support will improve the finished product; and
   - proceeding on our own, where we can commission more quickly but would lose some of the up-front benefits of collaboration.

# Introduction

6. This paper has been prepared by CE Electric UK Funding Company Ltd (CE) to inform interested parties of the activities of its licensees, Yorkshire Electricity Distribution plc (YEDL) and Northern Electric Distribution Ltd (NEDL), on innovation. It covers the six months ending 31 March 2005.

7. A single report has been prepared because both licensees are operated as a single entity, sharing best practice across the whole. Research and development is no exception, and we draw no arbitrary distinction between innovation carried out for the two licensees. Projects and programmes are therefore discussed only once. Finally, the report breaks out the relevant expenditure by licensee to support regulatory reporting requirements.

8. The 2004/05 report is the first of its kind, and is therefore something of a trial run. The next (2005/06) report is anticipated to evolve from this starting point in the light of experience, particularly as regards assessment of benefits. The sector has committed to work with Ofgem and contractors to enhance reporting and governance. It will also include all the projects listed in this report, as that later report will cover an eighteen-month period. Given the expected improvements in reporting, those projects may then be presented in a slightly different way.

9. The report focuses upon research and development work eligible for Ofgem's Innovation Funding Incentive (IFI). The IFI is intended to provide funding for projects focused on the technical development of distribution networks, up to and including 132 kV, to deliver value (i.e. financial, supply quality, environmental, safety) to end consumers. IFI projects can embrace any aspect of distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning.

10. In this context, 'technical' requires both that there is a significant engineering intellectual content, and that projects involve load-carrying assets or their control and electrical protection.

11. The paper has been prepared in accordance with the Regulatory Instructions and Guidance (RIGs) and the Energy Networks Association (ENA) Engineering Recommendation (ER) G85 (the Good Practice Guide (GPG)), which states:

    *3.4 Annual Regulatory Reporting Requirements for IFI Projects*

    *Ofgem requires a report to be published annually (i.e. by no later than the 31 July immediately following the end of the reporting year as required by the RIGs) by each distributor on its IFI [Innovation Funding Incentive] project activity…distributors will normally be required to provide the following information at the end of the reporting year and by no later than the immediately following 30 June [sic]:*

    *• IFI budget carry-forward*

    *• eligible IFI expenditure*

    *• eligible IFI internal expenditure*

    *• combined distribution network revenue*

    *• the IFI annual report.*

    *The minimum level of accuracy required when reporting to Ofgem is as follows:*

    *• IFI carry- forward nearest £1k*

    *• eligible IFI expenditure nearest £1k*

    *• eligible IFI internal expenditure nearest £1k*

    *• combined distribution network revenue nearest £0.1m*

*The IFI annual report will describe the IFI projects for which the distributor has incurred expenditure. The report should provide a summary of IFI project activities and details of costs and anticipated benefits of individual projects. A distributor may undertake one or more discrete programmes of IFI projects that are best grouped together to ease administration and reduce overheads. For each such programme a de minimis level of expenditure by an individual distributor of £40k per programme will apply. Individual projects with an annual expenditure below this level may be aggregated and reported as a programme…*

12. The programmes and major projects that will be discussed in this report are:
    - CE's internal innovation programme;
    - externally-driven activities, including:
        - the DTI/Ofgem Distributed Generation Co-ordinating Group (DGCG) and subsidiary workstreams;
        - the DTI Technology Programme; and
        - the IEE Technical Architecture project;
    - the EA Technology Limited (EATL) Strategic Technology Programme (STP) module 3 (cables);
    - EATL STP module 4 (substations);
    - EATL STP module 5 (distributed generation (DG));
    - the Energy Networks Association (ENA) IFI working group (covering relevant activities of the ENA Operations and Systems Group (OSG) and Approvals and Standards Group (ASG));
    - developing ENA ERs and Engineering Technical Recommendations (ETRs); and
    - Woodhouse steel girder mast replacement specification.
13. As permitted by the GPG, this report aggregates portfolios of projects under the STP and work for DTI.
14. This report will not address projects under Ofgem's' registered power Zone (RPZ) incentive, as there has been little fruitful activity within CE in the reporting window.
15. For information, RPZs are intended to encourage distributors to develop and demonstrate new, more cost-effective ways of connecting and operating generation that will deliver specific benefits to new distributed generators and broader benefits to consumers generally. The RPZ mechanism provides for an enhanced rate of return for distributors, by extending the general generation funding mechanism recently introduced by Ofgem.

## 'Early start' projects: 31 August 2004 letter

16. We wrote to Ofgem on 31 August 2004, outlining those 'early start' projects that we hoped to implement during the window of this report, specifically:
    - earthing studies, to be taken forward as an ENA OSG project in 2005/06;
    - fault level monitors, to be taken forward as an ENA OSG project in 2005/06;
    - Woodhouse mast replacement specification: timescales have slipped, but the Invitation to Tender (ITT) was issued on 4 March 2005. This project is covered in more detail later in this report;
    - HHT/AMS integration, i.e. providing the interface between potential hand-held tools for data collection with the NEDL asset management system: it has emerged during preparation of the GPG that this project would not qualify for IFI funding;

- land remediation: it has emerged during preparation of the GPG that this project would not qualify for IFI funding;
- failure investigation: no significant issues have emerged during the window of this report;
- STP module 0 – Technology Acquisition Module (TAM – the overall STP steering group); STP Module 3 – Cables; STP Module 4 – Substations; and STP Module 5 – DG: we continue to support these programmes, and each (save TAM, which is considered as an overhead across these modules) is covered in more detail later in this report;
- STP Module 2 – OHL: we have decided not to participate in this group, as we do not believe that it currently offers sufficient tangible deliverables for the benefits to outweigh the costs (which include the opportunity costs of our staff time);
- EATL Engineers' Forums; and Partial Discharge User Group: we continue to support these programmes, which provide operational feedback to validate closed projects, support existing work, and initiate new proposals. As these projects are intimately associated with STP modules, most are reported in conjunction therewith. The exception is the overhead line engineers' forum, which is discussed separately, as we do not currently subscribe to the main module.

17. The collaborative projects under ENA referred to in that letter are covered in this report under 'ENA IFI working group'; those under EATL STP are similarly covered in later sections.

## CE's internal innovation programme

18. Before we can engage effectively in any R&D, whether commissioned directly or via industry bodies, we need a robust process of governance and dissemination. During the window of this report, we have therefore:
    - developed, and received board approval for, an innovation strategy. This provides for:
        - a single budget-holder, supported by a cross-business working group, to bring previously-disparate workstreams together;
        - a clear approvals process to strengthen investment governance;
        - dissemination via this working group to improve the leverage of innovation investment; and
        - an aspiration to reach the full level of innovation investment provided by Ofgem under IFI, plus projects that deliver positive PV but fall outside the strict criteria of IFI;
    - developed, and received approval for, an innovation code of practice. This lays out in detail the way in which the cross-business working group will operate, and provides the framework for investment governance;
    - established the key documents (a work programme investment appraisal and supporting technical release) to permit effective governance; and
    - reviewed how R&D spend with external bodies may best be managed within the existing procurement process, to ensure best value and secure effective governance while minimising the administrative burden.

19. The cost of this overhead over the period of this report has been £12,625.

## Externally-driven activities

20. This section considers those projects driven by bodies outside the distribution sector where, although we have the choice as to whether or not we become involved, they fall outside our direct governance. We are, therefore, effectively unpaid sub-contractors.

*DGCG and subsidiary workstreams*

21. To address the barriers, real and perceived, to the connection of distributed generation (and particularly that using renewable sources), DTI and Ofgem established a Distributed Generation Co-Ordinating Group (DGCG).

22. Much of the work of this body is managed through its subsidiary Technical Steering Group (TSG) and its workstreams. Those bodies have commissioned a number of studies, funded by DTI, to assess and overcome engineering barriers to connecting generation. Notable outputs of this work include:

- a new recognition of the contribution of modern generation to system security (draft Engineering Recommendation ER P2/6); and
- a toolbox of 'basic active management' (BAM) solutions to reduce the costs of connecting generation to distribution systems.

23. We have been, and remain, strongly committed to the DTI/Ofgem DGCG and its subsidiary workstreams. Specifically, we provide:

- the chair for the TSG, with an ex-officio seat on the DGCG;
- members of the steering groups for TSG workstreams 3 (short-term solutions) and 5 (long-term solutions);
- a member of the technical architecture1 project team; and
- project managers for the TSG workstream 5 projects on losses, voltage rise and network design.

*DTI technology programme*

24. We have supported bids to the DTI for funding under their technology programme, and also actively supported successful projects. This includes the Econnect/NaREC RPZ feasibility study, which is carrying out a detailed assessment of the engineering and commercial opportunities to apply the RPZ concept described earlier to real developments on real networks.

25. If successful, we hope to carry forward some of these ideas onto trial sites, and seek RPZ recognition from Ofgem.

26. In a similar vein, we have provided support to the EST/EAGA-funded 'energy-free Edmondsley' project. This is a community-based energy scheme, seeking to stimulate the area through using PV, wind and ground-source heat at the village school and a potential new visitors' centre.

*North-East Energy Partnership*

27. We actively support delivery of the renewable energy targets laid out in the Energy White Paper through: chairing both the North-East Energy Partnership and its subsidiary networks solutions group; and participating in the One North East energy leadership council. While not directly eligible for IFI funding, these activities help us focus our efforts, identify new lines of research, and disseminate findings.

[1] although sponsored by the IEE, this takes its remit from the TSG

*Programme costs and benefits*

28. Neither the DGCG nor the DTI technology programme has published a definitive cost: benefit analysis. We estimate:

    - a PV of costs of £28,100; and
    - a PV of benefits of £38,500 through reducing investment consumption of generation-rich distribution networks.

29. We estimate that our contribution over the period of this report has been £17,550.

## EATL STP module 3 (cables)

30. This is a collaborative programme between EATL and distributors. A steering group manages a diverse portfolio of relatively low-value projects that have been identified by the module steering group members as significant and which require technical investigation and development. Most projects run across a number of reporting years.

31. 2004-05 (half-year) costs for CE were £19,300:

    - £15,900 for the module;
    - £1,600 for TAM costs;
    - £750 for the cable engineers' forum; and
    - £1,050 for CE Electric staff costs

32. Qualifying expenditure in previous financial years was zero.

33. The programme aims to reduce costs and improve performance of cable networks by increasing understanding of issues that have a negative impact on costs and performance. The programme is expected to also have a positive impact on safety and environmental performance.

34. The innovation involved is generally incremental, with some radical elements (such as the cable sniffer).

35. Three projects were approved for funding from the 2004/05 STP cable network module budget and commenced after September 2004, specifically:

    - S3/113-3 and –5: reduce the cost of reinforcement of the network, and reduce the risk of failure from over-rated cables, through developing the CRATER model. This model provides designers with a more accurate view of the capability of given cables under specific load and ground conditions;
    - S3/116: reduce the cost of duct failures through improvements to the duct specification EATS 12-24; and
    - S3/121: improve oil leak location and thereby reduce operating costs through developing an oil sniffer. By detecting the chemical traces of oil from above ground, this aims to pre-locate leaks and reduce the amount of excavation required.

36. The expected benefits of the programme lie primarily in reducing capital and operating costs, with marginal improvements in reliability and environmental performance. Expected timescale to adoption is (on average) 2 years; duration of benefit once achieved is (on average) 5 years; and estimated success probability (at start of project) varies between 10% and 50% between the projects.

37. PV of project costs[2] is £13,543; PV of project benefits is £17,488.

[2] all STP benefits are currently provisional, subject to review with EATL

38. Pre-existing projects in this module completed during 2004/05 are:

- S3/100-2: specification for link boxes stage 2, to increase reliability and thereby reduce operating costs;
- S3/113-1: current rating tools for cables stage 1, to extend the functionality of the existing CRATER cable-rating software to include user-defined input of load curve;
- S3/113-2: current rating tools for cables stage 2, to create a tool to calculate ratings of cables in banks of ducts;
- S3/115: corrosion resistance of aluminium foil cables, to reduce corrosion in 132 kV foil laminate cables; and
- S3/120: burn-back of cables in ducts, basements and ducts, to test coating systems which can prevent the propagation of fire along PE sheathed cable.

39. CE is currently reviewing the application of CRATER in re-assessing cable capability, to assist our network design processes.

## EATL STP module 4 (substations)

40. This is a collaborative programme between EATL and distributors. A steering group manages a diverse portfolio of relatively low-value projects that have been identified by the module steering group members as significant and which require technical investigation and development. Most projects run across a number of reporting years.

41. 2004-05 (half-year) costs for CE were £24,850:

- £15,900 for the module;
- £1,600 for TAM costs;
- £750 for the plant engineers' forum;
- £1,500 for the protection engineers' forum;
- £3,000 for the partial discharge user group; and
- £2,100 for CE Electric staff costs.

42. Qualifying expenditure in previous financial years was zero.

43. Issues with the age profile of substation assets within the UK electricity distribution system are well known. The challenge is to constantly review and innovate new solutions to monitor and define asset condition thereby allowing risks to be clearly defined and sound investment decisions to be taken.

44. The programme of projects encompasses both developing new innovative asset management processes and practices and developing innovative diagnostic techniques. The aim is to develop already well established themes such as life extension of aged assets within legal and heath and safety constraints, examination of new technologies, developing an understanding of, and innovative solutions for, the impact on substation assets of increasing levels of distributed generation on networks and condition monitoring techniques.

45. The innovation involved is generally incremental.

46. Five projects were approved for funding from the 2004/05 STP substations network module budget and commenced after September 2004, specifically:

- S4/107: establish new techniques for assessing the condition of oil-filled circuit breakers by developing an understanding of head space gases generated during oil degradation. This builds on recently-developed live tank oil sampling (LTOS) techniques for HV switchgear, to allow us to draw off a gas sample from live equipment to assess its condition. This avoids the costs otherwise required to isolate the equipment and inspect through partial dismantling;
- S4/130-3: develop and improve the performance of oil-filled equipment-cleaning techniques. The performance of this equipment relies upon the integrity of the insulating oil. We therefore seek methods that minimise the risk of leaving contaminants in the tank after cleaning;
- S4/162: develop new tools to increase the voltage range of substation plant that can be monitored non-intrusively through partial discharge mapping. This builds on the recently-developed UltraTEV monitor to pick up the electromagnetic pulses associated with insulation breakdown. In turn, this provides early warning of potential switchgear failure, improving staff and public safety, and allowing remedial work to be managed pro-actively;
- S4/164: develop non-intrusive techniques to monitor the performance of on-load tap changers. This project will develop techniques to allow us, with confidence, to understand the condition of these assets without being forced to isolate the equipment and inspect through partial dismantling; and
- S4/167: refine the Condition-Based Risk Management (CBRM) process by developing enhanced algorithms. CBRM uses a simple probabilistic approach to predicting the probability of failure. There would be benefits in changing the exponential relationship to one which more closely represents the physical processes of degradation, particularly close to end of life.

47. Pre-existing projects carried forward include developing embedded communications to allow information from large numbers of small distribution substations to be acquired remotely via the power distribution network (S4/161). Currently, we acquire real-time information from only a limited number of sites. One barrier is the cost of communication, which this project seeks to overcome.

48. A scoping study has also been commissioned on the potential for extending transformer service life through refurbishment (S4/172). This seeks to unlock the economic benefits of investing relatively small sums now to defer much larger investment, while maintaining acceptable asset and network risk.

49. The expected benefits of the programme lie primarily in reducing capital and operating costs, with marginal improvements in reliability and environmental performance. Expected timescale to adoption is (on average) 3 years; duration of benefit once achieved is (on average) 15 years; and estimated success probability (at start of project) is 25% across the projects.

50. Costs and benefits of the portfolio[3] are £11,613 and £19,590 respectively.

51. Pre-existing projects in this module completed during 2004/05 include:

- S04/99-3: extension of TASA (tapchanger signature analysis) trial, to enable a condition-based maintenance strategy to be implemented for on-load tap changers. This presents another opportunity for non-intrusive diagnostics;
- S4/130-2: dry wipe assessment, for cleaning the tanks of HV oil-filled equipment during maintenance (see S4/130-3 earlier);

[3] all STP benefits are currently provisional, subject to review with EATL

- S4/146: impact of distributed generation, to take into account factors, issues and implications for substation plant such as increased fault levels and reverse power flow;
- S4/147: on-line oil regeneration, to reduce the cost of maintenance by minimising the need to buy in reconditioned insulant;
- S4/149: reliability of existing and newly-installed plant, to provide an objective assessment of the extent and severity of performance issues. This project is looking to challenge the hypothesis that modern plant is not as robust as that which has been on the system for some time;
- S4/150: Arc Suppression Coil (ASC) systems, to report the issues that need to be considered when applying this technology to UK distribution networks rated up to 36 kV. This project will build on existing UK experience which is generally limited to 20 kV; and
- S4/155: investigation of ester-based insulating oils, to understand where on the system most advantage would be gained from the use of vegetable-based oils.

## EATL STP module 5 (DG)

52. This is a collaborative programme between EATL and distributors. A steering group manages a diverse portfolio of relatively low-value projects that have been identified by the module steering group members as significant and which require technical investigation and development. Most projects run across a number of reporting years.

53. 2004-05 (half-year) costs for CE were £20,300:

    - £15,900 for the module;
    - £1,600 for TAM costs; and
    - £2,800 for CE Electric staff costs

54. Qualifying expenditure in previous financial years was zero.

55. The projects were aimed at: enabling cost effective DG connections; and ensuring techniques are in place to plan, operate and manage networks with significant amounts of generation. Most projects also had positive impacts on safety and environmental performance

56. The innovation involved is generally radical.

57. Four projects were approved for funding from the 2004/05 STP DG network module budget and commenced after September 2004, specifically:

    - S5/081: voltage control policy assessment tool, to assist in maintaining network voltages within limits. A key impact of distributed generation on HV systems is creating voltage rise where demand alone would cause voltage fall. Designers require novel tools to ensure that generation-rich systems are developed economically;
    - S5/123: installation of line voltage regulators in networks with distributed generation. This is one voltage control option already used to accommodate demand, and offers scope to minimise the impacts noted under S5/081;
    - S5/124: solutions for increasing impedance of network components. This was identified under BAM, and aims to minimise the impact of DG on fault level, hence reducing connection costs; and
    - S5/145: dynamic circuit ratings, to increase the amount of power to be carried by existing distribution circuits without exceeding thermal and safety limits. This has a broad application to reducing the costs of connection and reinforcement for both demand and generation customers.

58. With government policy driving significant increases in generation connection to distribution networks the project provides a range of innovative solutions to connection and network operation issues that are cost effective and which maintain the present level of network reliability and safety. Specifically, benefits include:

- reducing the probability of voltage supply limit excursions resulting from increased distributed generation;
- reducing network reinforcement expenditure; and
- improving reliability.

Expected timescale to adoption is (on average) 1 year; duration of benefit once achieved is (on average) 3 years; and estimated success probability (at start of project) varies between 5% and 100% between the projects.

59. Costs and benefits of the portfolio[4] are £6,157 and £15,191 respectively.

60. Pre-existing projects in this module completed during 2004/05 include:

- S5/100-2: enhancing protection and control systems to maximise network benefits. This aims to co-ordinate settings in the presence of DG, maintaining safety at all times, but now optimising for continuity for all users;
- S5/113: seminar on module 5 work on stability, to transfer knowledge from 8 STP projects to design engineers;
- S5/119: stability assessment policies: a best practice guide to communicate the output from previous STP projects on stability;
- S5/122-2: guidance as to Loss of Mains (LOM) protection settings on distribution networks, to ensure customers see the minimum number of loss of supply events. No generator can be permitted to export onto a faulted network. By refining the protection, we can confine this restriction to when there definitely is a fault rather than when there might be;
- S5/125: BAM solution 2.1 - uprate network components, to investigate the engineering, practical and fiscal considerations and constraints associated with the options of holding the 11 kV fault level at the design fault level of 250 MVA during normal running arrangements and increasing the design fault level;
- S5/126: BAM solution 2.3 - converter technology, to obtain outline costs and high-level technical benefits for commercially-available converters across a range of generator types;
- S5/130: network risk management, to assist distributors' understanding of the issues surrounding increasing network utilisation and reliance on DG, to avoid network reinforcement associated with the draft P2/6 network security standard;
- S5/133: tap-changers - reverse power capabilities, to create a definitive reference document of equipment's reverse power capability. With increasing penetration of DG, power flows will change and ultimately reverse. Older transformers were never designed for this duty, and have varying capabilities. By understanding these issues, we can minimise connection costs by upgrading only where absolutely necessary;
- S5/139: potential of RPZ framework, to define specific RPZ scenarios and quantify the commercial issues, in order to facilitate the identification and establishment of optimum RPZs; and

[4] all STP benefits are currently provisional, subject to review with EATL

- S5/140: domestic CHP potential, to establish a time plan against which distributors may have to respond with technical solutions to the supply quality and financial implications. This facilitates the economic development of the network by providing a more accurate planning baseline.

## ENA IFI working group

61. This group has provided valuable support to the development of the IFI GPG, now ER G85. It also provides a forum to discuss relevant activities of the ENA Operations and Systems Group (OSG) and Approvals and Standards Group (ASG), where funding is provided through existing OSG and ASG mechanisms.

62. CE contends that this activity qualifies for IFI funding as it is entirely focussed on innovation, and forms a key part of governance of sector-wide research and development. This group is therefore significantly different to other groups such as OSG and ASG, which generally address business as usual and therefore do not feature in this IFI report.

63. 2004-05 (half-year) costs for CE were £2,100

64. Qualifying expenditure in previous financial years was zero.

65. The group is operating now, and we expect it to have a certain benefit of 1% of R&D programme size over the next five years.

66. We expect our contribution to the group to have a PV of costs of £7,300, with a PV of benefits of £11,700, through more effective targeting of R&D expenditure.

67. Of the projects discussed within this group, none proceeded to tender during the window of this report. Work on developing ER G78 has been discussed by that group, but is reported here under 'Developing ENA ERs and ETRs'.

## Developing ENA ERs and ETRs

68. Some Engineering Recommendations largely codify existing best practice, and therefore fall outside the scope of IFI. Others involve research to advance the state of the art, and the subsequent dissemination of that knowledge. We submit that these latter fall within the scope of IFI, and have therefore included them in this report

69. 2004-05 (half-year) costs for CE were £7,100, charged to us under the ENA cost pooling arrangements.

70. Qualifying expenditure in previous financial years was zero.

71. ER G78 addresses connection of Mobile Phone Base Stations (MPBS) to HV towers. There is a safety issue over transfer of potential between the system supplying the base station and the system of which the supporting tower is a part. The project commissioned consultants to develop new methods of connection that isolate the two systems from each other. This had (across the sector):

    - potential reduction in connection costs of £30,000 pa;
    - expected timescale to adoption of 1 year;
    - duration of benefit once achieved of 5 years; and
    - estimated success probability (at start of project) of 50%;
    - PV of costs of £50,152; and
    - PV of benefits of £61,668.

72. ER P2 addresses security. This project took the academic research commissioned by DTI into assessing the contribution of modern generation to system security and facilitated its application to real networks. This had (across the sector):

- potential reduction in costs of £9,600 pa, from reducing the need for system reinforcement by more accurately reflecting the contribution of DG to system security;
  - expected timescale to adoption of 1 year;
  - duration of benefit once achieved of 10 years; and
  - estimated success probability (at start of project) of 50%;
  - PV of costs of £9,400; and
  - PV of benefits of £33,870.

73. Both of these documents now form part of our policy baseline, and will flow through to investment appraisals as customers present their requirements.

74. As noted above, routine meetings of OSG, ASG, and their sub-groups relating to projects that do not involve external research and development, are generally business as usual and therefore do not feature in this IFI report.

## Woodhouse steel girder mast replacement specification

75. In the 1930s, YEDL's predecessor, the Yorkshire Electric Power Company, built a range of long-spanned 11, 33 & 66 kV steel girder mast lines, commonly known as the "Woodhouse mast designs".

76. The "Woodhouse steel mast" supports were originally designed to accommodate 0.15" (7/.166") HDBC & 0.1" (7/.136") HDBC conductors using three basic design spans of 500 ft, 650 ft and 700 ft. A number of the circuits were later reconductored with 0.175" (37/.110") conductors designed on a 700 ft basic span. This was achieved without the need to carry out any alterations to the existing supports.

77. Over time the majority of 11 kV supports have been replaced with traditional wood pole alternatives, the majority of them resulting in interpoling as a means to reduce the long span lengths. A similar approach has been applied to the 33 and 66 kV circuits, but difficult wayleaves situations mean that around 300 km still remain.

78. The original specification cannot be re-used as it does not conform to current overhead line design requirements. Existing current designs such as AP1 or our proprietary OHL 9 and CE/C/37 specifications are limited to a span length of around 150m.

79. The challenge facing us is that we have around 300 km of an asset that is critical to system security and, dependent on land use, a hazard to the public as it deteriorates. The absence of a like-for-like replacement renders it difficult to obtain wayleaves for routes using current designs. This has already led to our undergrounding one circuit in its entirety (Thurcroft-Mexborough-Edlington) and a high-risk section of another (the tee to Crowle). The high costs involved were justified by the pressing need to replace these lines before they posed an unacceptable risk to public safety.

80. 2004-05 (half-year) costs for CE were £2,000.

81. Qualifying expenditure in previous financial years was zero.

82. Anticipated benefits come from reducing the costs of rebuilding these lines by £15,000 pa, as we would continue to address clear and present safety issues by undergrounding if necessary, giving:

- expected timescale to adoption of 2 years;
- duration of benefit once achieved of 10 years; and
- estimated success probability (at start of project) of 75%;
- PV of costs of £48,250; and
- PV of benefits of £79,400.

83. We issued an invitation to tender on 4 March 2005 for the preparation of a specification for a replacement that conforms to current mechanical loading requirements, uses the same span length and fits within 10% of the existing silhouette.

## Other small projects

84. The only other activity during the reporting window was participation in the EATL overhead line engineers' forum. While the parallel groups for cables and substations are included in our consideration of the relevant STP modules, this cannot be done for overhead lines as we do not currently subscribe to that STP module.

85. 2004-05 (half-year) costs for CE were £1,100 (£750 for the forum, plus £350 of internal costs).

86. Qualifying expenditure in previous financial years was zero.

87. The benefits to CE accrue mainly through being better informed about recent innovation, but also through providing the basis to take specific R&D projects (such as the Woodhouse mast replacement specification) forward.

88. The group is operating now, and we expect it to have a certain benefit of 0.01% of OHL programme size over the next ten years.

89. We expect our contribution to the group to have a PV of costs of £7,300, with a PV of benefits of £11,700, through more effective targeting of R&D expenditure, giving:

- PV of costs of £15,500; and
- PV of benefits of £19,300.

## Projects considered but not taken forward

90. Two 'early start' projects were shown not to comply with the detailed requirements of IFI as laid out in the GPG, specifically:

- HHT/AMS integration, i.e. improving the efficiency of data collection during inspection and overhaul; and
- land remediation through tailored application of micro-organisms.

91. During 2004/05, we were approached to support a number of bids for funding under the DTI technology programme. Some were not taken forward as an acceptable business case could not be established, specifically:

- development of a Super-conducting Fault Current Limiter (SFCL) by Applied Superconductors Limited (ASL); and
- a project to apply cyclic thermal ratings to active constraint management, by a PB Power-led consortium.

92. Under the CE internal programme, a number of 'bright ideas' were raised but not taken forward to full project proposals. Some were not taken forward as an acceptable business case could not be established, specifically

- development of remote monitoring for all DG connection points;
- development of fibre optic pilots;
- oil leak location and monitoring through:
  - telemetry for the 'oil van' to log and provide a range of data such as oil condition, volume pumped, location data, oil pressure data etc.; and
  - cable pressure monitoring devices fitted along the route;
- developing OHL aerial surveys (here, the project is valuable and therefore being taken forward, but not sufficiently novel to qualify for IFI).

93. Other projects raised internally have been placed on hold as, although they are likely to be valuable in themselves, there may be more productive avenues to explore, including:

- assessment of the scope for using existing and near-market technologies for energy storage to be owned and operated by the distributor;
- developing cost-effective power quality monitoring at key sites; and
- developing new design tools for LV networks to take account of increased distributed generation.

94. A number of other concepts were raised during 2004/05 that we hope to develop further during 2005/06.

## NPV methodology

95. We have adopted a simple, robust and transparent approach to assessing costs and benefits. For each project, we have assessed both costs and potential benefits over a 15 year window, discounted back at 6.9% pre-tax real. Figures for the STP modules have been built bottom-up from values for individual projects provided by the contractor. These have been scrutinised to validate estimated benefits.

96. The benefit valuations are necessarily a matter of engineering judgement, but generally take the form of assessing the size of the issue and a credible reduction in unit costs. To reduce subjectivity, we seek to benchmark these assessments externally (e.g. through peer review under STP).

## Summary of current portfolio

97. We can summarise the discussion above to yield a set of costs and benefits[5] for ongoing projects across the portfolio:

| programme | costs | PV benefits | cost: benefit ratio |
|---|---|---|---|
| DTI technology programme | £28,100 | £38,500 | 73% |
| STP 3 | £13,543 | £17,488 | 77% |
| STP 4 | £11,613 | £19,590 | 59% |
| STP 5 | £6,157 | £15,191 | 41% |
| ENA IFI WG | £7,327 | £11,747 | 62% |
| ER G78 | £50,152 | £61,668 | 81% |
| ER P2 | £9,407 | £33,870 | 28% |
| Woodhouse mast replacement specification | £48,250 | £79,382 | 61% |
| EATL OHL engineers' forum | £15,524 | £19,262 | 81% |
| **total** | **£190,073** | **£296,698** | **64%** |

98. We can also derive the overall portfolio summary required by G85:

| | |
|---|---|
| Number of active IFI projects | 22 |
| NPV of costs and anticipated benefits from committed IFI projects | £106,625 |
| Summary of other benefits anticipated from active IFI projects | Marginal improvement in reliability |
| Total expenditure to date on IFI projects | £107,700 |
| Benefits actually achieved from IFI projects to date | nil |

99. At this stage in the programme, we would not have expected to reap any benefits.

[5] all STP benefits are currently provisional, subject to review with EATL

# Summary of 2004/05 IFI investment

100. We can also summarise the discussion above to give costs incurred over the reporting window of:

| **programme** | **external costs** | **internal costs** |
|---|---|---|
| DTI technology programme etc. | 17,550 | 0 |
| STP 3 | 18,250 | 1,050 |
| STP 4 | 22,750 | 2,100 |
| STP 5 | 17,500 | 2,800 |
| OHL engineers' forum | 1,500 | 350 |
| ENA IFI working group | 0 | 2,100 |
| developing ENA ERs and ETRs | 7,100 | 0 |
| Woodhouse mast replacement specification | 0 | 2,000 |
| CE internal programme | 0 | 12,625 |
| | | |
| **unconstrained sub-totals** | **84,650** | **23,025** |
| | | |
| **constrained sub-totals** | **84,650** | **14,938** |

101. This allows us to provide the data specifically requested in the RIGs, split 40:60 in proportion to size of licensee:

| | **NEDL** | **YEDL** |
|---|---|---|
| **eligible IFI expenditure** | 39,800 | 59,800 |
| **eligible IFI internal expenditure** | 6,000 | 9,000 |
| **combined distribution network revenue** | 159,738,000 | 229,747,000 |
| IFI constrained total as % turnover | 0.025% | 0.026% |

102. It can be seen that around £8,000 of internal costs may need to be excluded from IFI funding, as they exceed the 15% threshold set out in the RIGs. This is to be expected, as: there are significant start-up costs in establishing robust governance; and because our financial contribution to the collaborative projects is highly-geared, so our direct participation becomes disproportionately large.

103. We shall review the situation at the end of the 2005/6 reporting year, as we hope to have improved the ratio between project work and programme management and thereby eliminate the issue. Failing that, we may raise the issue with Ofgem and seek a relaxation on the 15% limit.

104. Note that there is no IFI carry-forward for 2004/05, as this does not become a meaningful concept until the end of the 2005/06 reporting year.

## Outlook for 2005/06

105. On our internal process, we will: finalise the key documents (a work programme investment appraisal and supporting technical release template) to permit effective governance; and review the code of practice. This will support a drive to generate additional project proposals during 2005/06, so that we may begin more fully to exploit the opportunity presented by IFI.

106. We will strive towards a 50% uplift in spend from 2004/5 to 2005/6, i.e. a full year total of around £300,000. While only around 15% of the potential of the IFI scheme, we are less concerned with setting ourselves some arbitrary target than in identifying projects that address real business need and are likely to deliver value for money, and in delivering these by a collaborative route where possible.

107. This will be achieved through:

- continuing to support:
  - the successors to the DGCG and subsidiary workstreams;
  - EATL STP; and
  - ENA collaborative work; and
- expanding our activities into:
  - the Supergen V programme of work;
  - the Woodhouse mast replacement specification; and
- further projects, collaborative where possible but alone if not.