

SDS Design Assurance – An historical overview

1) Introduction

There are 2 key issues of concern with BSC in relation to design:

- 1) the difference in design between the “Base Date Design Information” (BDDI) and what has been finally issued for construction by SDS in the form of “Issued for Construction” (IFC) packages. Currently, **tie** has limited information from BSC relating to the reasons for changes.
- 2) The slippage in the design programme.

The delivery of the tram design by Parsons Brinkerhoff (SDS) has been problematic since the award of the contract in September 2005. In particular, SDS consistently has failed to produce evidence of effective Design Assurance and design integration across all disciplines.

This overview explores the history behind the design process as part of the ongoing work to tease out any relationship between design, design integration, late issue of designs and design changes.

2) SDS (Parsons Brinckerhoff) Contract with tie

tie awarded the design contract known as “SDS” (System Design Services) to Parsons Brinkerhoff in September 2005. The design was to be delivered in 2 stages, preliminary design followed by detailed design. In addition, a separate this contract provided for the utility diversion design – this is not covered in this overview. Once SDS design had been completed, Infracore would ‘take it over’ and complete it, principally in the areas of track design, tramstop detailing and electrical systems, but not utility design.

Need a comment on the original dates for the delivery of the preliminary and detailed designs and when each was or is currently programmed to be completed.

Also need to have a comment about what was expected in terms of design assurance

In early 2007, **tie** agreed with SDS that their final detailed design would be submitted for review in self-assured packages, each package being accompanied by a so-called “Design Assurance Statement” or DAS. The DAS content was agreed with **tie** and is enshrined in Schedule 14 to the Infracore Contract. The DAS was intended to demonstrate how the offered SDS design met all the requirements, fulfilled standards, was cost effective and mitigated applicable safety hazards, as well as being a fundamental configuration control document – what documents and design drawings together comprised an integrated design package for each route subsection plus a separate package covering system-wide issues.

There are several clauses within the SDS contract which are especially relevant to this overview:

- Section 3 set out the required service. Inter alia, it required SDS to:
 - 3.3.3 – (perform the services) “in accordance with the SDS provider’s quality management system and plans”. As detailed below, these plans included provision for SDS’ own “Design Verification Statements”- which through discussion and refining became the DAS’ to be accepted by **tie**.
 - 3.3.7 - “ensure compliance with all applicable Law and Consents.” ‘Consents’ are defined within the Contract and include all such “from the Approval Bodies” – ‘Approval Bodies’ also being defined within the Contract as including HMRI. Experience has shown that, despite a promising early start, SDS became extremely reluctant to liaise with and follow HMRI (in practice “HMRI” became the ROGS-required “Independent Competent Person” –

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ICP) requirements and only very recently, and following intervention by **tie**, has resumed presentations to the ICP for the purpose of seeking his "No objection" to their design proposals.

- Schedule 9 of the Contract – "Review Procedure" – included in para 5.1 the disclaimer "No review, objection, comment or silence by the Client shall operate to (i) exclude or limit the SDS Provider's obligations or liabilities . . .". The same Schedule described the process by which the Client would review any SDS deliverables. This is important because, as the problems worsened with SDS, it was decided that IFC packs would be issued on a fully self-assured basis in advance of the **tie** review which was intended to take place as part of the overall DAS pack review.

In addition to these requirements, the final contract clarification note provided to SDS included a relevant section:

EDINBURGH TRAM NETWORK

Clarification Note to Tenderers participating in the procurement for the provision of System Design Services (SDS)

29 April 2005

The obligation on the SDS Provider to be responsible for obtaining the Consents is a fundamental requirement of the SDS Agreement. (See clarification question).

3) SDS quality management

In response to a request by **tie**, and in order for **tie** to understand better their management system following quality concerns, SDS made a presentation to **tie** on 7th November 2006 on their Quality Management System, Design Assurance and Approval and Design Production processes

This included three slides relevant to this overview:

The process and proposals for assurance of quality:

- ❖ are part of PB's standard offering,
- ❖ Tailored and adapted for the SDS project
- ❖ were included in our original submission to **tie**,
- ❖ and have been implemented (and refined) since day one

PB's normal processes are based upon:

- ❖ documented generic and customised procedures and processes
- ❖ Focus on processes and procedures that "work"
- ❖ being managed in, policed, audited and corrective actions applied
- ❖ SDS Detail Design Phase Process
 - *Structured assurance evidence*
 - *Progressive assurance*
 - *Assurance against the requirement specs*
 - *Assurance against industry standards*
 - *Section Design approval*
 - *Overall Tram Network System design approval*

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Design Assurance and Approval Key Assurance activities

- ❖ Intermediate Design Reviews
- ❖ Drawing reviews and sign off
- ❖ Document reviews and sign off
- ❖ Interdisciplinary Checks
- ❖ Design Verification Statements
- ❖ System Detail Design Review

Design Assurance responsibilities

In early 2007 it became obvious that clarity needed to be brought to the responsibilities for design assurance. This was as a result of emerging quality problems and was principally to ensure that SDS' own QMS processes were effective, visible and produced the evidence required to underpin their self-assurance of detailed design. Without this assurance it would have been impossible to gain "No objections" from the approval authorities.

The key requirements within PB's own Quality Management System had been summarised by tie on 23rd February 2007 and are included as Appendix A to this overview.

The content of self-assurance and the associated responsibilities were discussed extensively with SDS and are summarised in the key email trail within Appendix B to this overview.

SDS design review in practice

Design Review sessions had been held before I joined the project in prior to February 2007 and had been led by Trudi Craggs and Gavin Murray, calling upon the then quite large group of TSS resources.

How did this design review fit in with the design assurance process and what was the design review intended to achieve?

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From Feb 2007 onwards they were conducted on the basis of SDS being required to justify their design according to the requirements - which are the same as those included within Schedule 14 of the Infracore Contract. From this point on, the intention was that tie would only review completed so-called (by SDS) "Design Assurance Statement" (DAS) packs on the basis that these would cover all design and be completed before construction commenced.

Early design reviews, of supposedly complete and integrated design within 'draft' DAS packs, revealed a multitude of areas where SDS design was unsatisfactory as far as tie and CEC were concerned, some where TSS expert scrutiny required more explanation and some (e.g. the safe control of trams reversing in the streets) where the Operator was concerned about safety. There were always many issues concerning non-integration due to ineffective co-ordination of the various disparate design teams within SDS.

By May 2007, SDS had produced a supposedly better draft DAS, for route section 5C, which, whilst appearing to be comprehensive, was really only a list of documents comprising the design of a route section. It did not demonstrate how the design fulfilled its requirements and it did not demonstrate how safety hazards had been mitigated – these two factors being critical to the ultimate acceptance of design as being fit for purpose and acceptably safe for operation.

In 2Q07, SDS started to issue schedules of when design packages would be ready for review. The schedules never worked because SDS was never ready to fulfil them. A key reason for this the massive

volume of CEC comments on offered design, resulting in a continual hiatus within SDS design sections in attempting to determine whether the comments were valid and, if they were, to address them – these SDS processes being invisible, but very obviously slow.

The ROGs-required Competent Person (known as the “Independent Competent Person”), John Dolan, was appointed in June 2007 and started working with **tie** in July 2007. From that point on, he was present at most design review sessions and took an active and most beneficial part in this activity. When issues arose where **tie** required his formal opinion on matters of concern, we were able to get his formal opinion in the form of an ICP’s RFO (“Request For Opinion”). Where he required a formal response from us on a matter of concern to him he would issue us with an ICP’s RFI (“Request For Information”) or, alternatively, an ICP’s ANC (“Advice of possible Non-Compliance”) if he felt the matter was of more significant concern. These ICP’s RFOs and RFIs have proved to be a most useful way of bringing pressure to bear on an otherwise unresponsive SDS.

In the absence of completed packages, **tie** set up review sessions to examine the various packages in whatever state that they happened to be at the time of review. Before the joint review sessions took place the design packages were made available to reviewers (stakeholders) so that they could examine their areas of interest and get their questions ready. Each review session started with a presentation by the SDS Design Team Leader, together with key design experts, and enabled all stakeholders to raise their questions. The questions and answers were recorded in Records of Review which were supplied to SDS. These reviews were done on a route sub-section basis, e.g. sections 1A, 2A, 6 etc and covered the entirety of the route.

Dates for the submission to **tie** of completed DAS packs continually slipped. In SDS’ view this was principally due to their continuing and seemingly endless dialogue with CEC as part of the progress to closure of CEC Technical and Prior Approvals issues. This is graphically illustrated in the following embedded spreadsheet which shows the situation between the slippage between SDS programmes V17 and V33 . . .



The incomplete designs for the whole route were reviewed in this way. Following that, the plan was that the next formal reviews of SDS design would be conducted on completed DAS’, i.e. when the design had been completed and the associated underpinning safety hazard mitigation arguments assembled. We are still awaiting a schedule of the submission dates for these.

By this time, because of the obvious lack of work for them due to the continuing unforthcoming DAS packs, the TSS resources assigned for design review had been altered to become a significantly smaller as-required, rather than full-time in-house facility. Had those TSS resources remained in place at that time it is possible that they might have been used to review incremental design output from SDS, rather than just the intended complete DAS packs.

The present status is that **tie** is waiting for the finalised DAS packs for review. BSC has said that they will add their input and submit overall integrated DAS packs in due course. Despite formal letters to BSC asking for a programme for submission of these packs, so far only verbal advice has been received by **tie** that the first such pack ‘might be available in 3Q10.

By chance, the slump in SDS DAS review activity was almost exactly counteracted by a rising tide of submissions from BSC for their electrical systems and track, all of which needed detailed review because of the high risk nature of their content. Just as this **tie** review activity was starting, a decision had been made to incentivise SDS for the production of IFC packs so that construction could commence in earnest. At that

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Comment [s1]: SDS were incentivised as part of the novation agreement and before BSc start making submissions.

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time SDS had adopted an exceptionally hard commercial stance, claiming that the 'change' work being demanded of them was outwith their contract. So it is highly likely that this incentivisation 'carrot' was seized enthusiastically by SDS and took their attention off the production of DAS packs (which actually are essentially IFC packs but with the addition of the critical inbuilt safety self-assurance information) thus leading directly to the unfortunate de-linking of SDS design from the production of their self-assured DAS packs and possibly reducing their vigilance and coverage in performing the critical interdisciplinary (and indeed 'sense') checks required by their own QMS before issuing any 'complete' design.

Hence, construction is now proceeding to allegedly self-assured (by SDS) but unreviewed (by **tie**) IFC packs without their having been demonstrably fully integrated within themselves and with BSC design. BSC has recognised this and is no conducting interdisciplinary reviews and checks to pick up errors of integration. There is hence a risk that some constructed works might be flawed in design terms and also that there might be design errors that preclude closure of safety hazard risks. The latter is unlikely to occur because of the early design review activity covering all credible safety risks. However, the latter might occur and result in abortive works and subsequent corrective action.

Current work on safety hazard mitigation arguments (evidence)

After Infraco contract let, BSC established their System Assurance team and took stock of the SDS Hazard Log status. It became apparent by late 2008 that much work needed to be done to enable the safety arguments in support of hazard mitigation to be located, such that those hazards could be proposed to **tie's** Programme Safety Certification Committee – PSCC – for closure. This was because SDS documents which were needed to facilitate this were not evident.

Much preliminary work was done by BSC working with SDS during 2009. During the first half of 2010 further such joint work will be done to detail the available evidence and identify where gaps exist that need closure; **tie** will work closely with BSC on this critical activity.

BSC IDR/IDR and DAS processes

BSC has produced a process to cover this activity, which fits within their recently completed suite of System Assurance documents. Inter alia, it provides for DAS' being produced to cover ALL design, not just that by SDS. Such DAS' will be reviewed by the Infraco Contract Schedule 14 process. We are still awaiting a programme for the submission of these to **tie**.

Requirements management/V&V

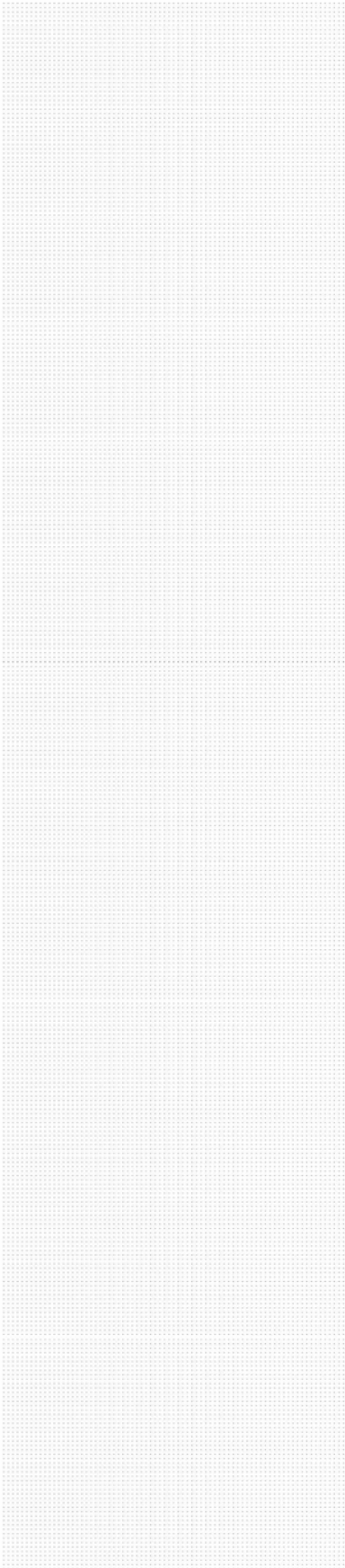
Since the DAS' cover design ONLY, the need arises for BSC to demonstrate how they have verified that the design has indeed been constructed and commissioned. It is expected that fulfilment of BSC's Requirements Management and V&V processes will fulfil this need and include the verifiable evidence to support it.

Cases for Safety

BSC is required to produce Cases for Safety at various stages of the project. These bring together all the work that SDS and they have done to demonstrate that the overall tram system will be fit for purpose and acceptably safe. They will be reviewed by the Infraco Contract Schedule 14 process.



Tony Glazebrook
Engineering Services Director, tie ETN Project



Appendix A

tie's 23rd Feb 2007 summary of the key requirements of PB's own Quality Management System

1. Proposal:

- 1.1. To introduce a design assurance process for SDS output such that it is inherently self-assured.

2. Method:

- 2.1. The process builds upon the SDS (PB) Project Management Plan already produced for the project, document ULE 90130-SW-SW-PPN-00001, Version 5. This document details the Procedures for Control and Monitoring, - section 4 - and includes processes for:
 - 2.1.1. Issue to SDS' own Review Process – section 4.1.2
 - 2.1.2. The SDS Approvals Manager agreeing documents for submission to tie and third parties, and the scheduling thereof, including details of for what purpose the document has been submitted for review – sections 2.5.1 and 4.1.2
 - 2.1.3. The construction of a System Integration Matrix to be managed by SDS' Systems Integration Management team – section 2.7.1.
 - 2.1.4. Interface management and systems integration – section 4.4
- 2.2. For this purpose, the key elements within the Project Management Plan are the:
 - 2.2.1. Quality Management Plan – document ULE 90130-SW-SW-PPN-00003, version 5. This document includes processes for:
 - 2.2.1.1. Design Review – section 6.4. Inherently, this embraces IDC and IDR activity
 - 2.2.1.2. Design Verification and Validation – section 6.7
 - 2.2.2. Configuration Management Plan – document ULE 90130-SW-SW-PPN-00004, version 5. This document includes processes for:
 - 2.2.2.1. The required tram system build configuration, including configuration audits
 - 2.2.3. Approvals & Consents Management Plan – document ULE 90130-SW-SW-PPN-00007, version 5. This document includes processes for:
 - 2.2.3.1. Constructing an approvals and consents management plan
 - 2.2.3.2. Obtaining consents for planning, Roads, environment, construction
 - 2.2.3.3. Detailing Parliamentary Agreements and Third-Party undertakings
 - 2.2.4. Verification and Validation Plan – document ULE 90130-SW-SW-PPN-00005, version 5. This document includes processes for:
 - 2.2.4.1. Compilation of the test requirements database, which details how every system requirement is to be met through V&V activity – section 2, including:
 - 2.2.4.1.1. Design checking – the first defence against error!
 - 2.2.4.1.2. Design proving against requirements
 - 2.2.4.1.3. RAM management
 - 2.2.4.1.4. EMC
 - 2.2.4.1.5. Constructability
 - 2.2.4.1.6. Audits
 - 2.2.4.1.7. Testing and commissioning

2.3. Currently, SDS is responsible for design, TSS for design check and tie for final design approval and client decision-making on behalf of CEC and TS. *1 (see below)

2.4. The proposal is that henceforth, for each project element the following responsibilities are taken:

- 2.4.1. Production of design to requirements - by SDS designer
- 2.4.2. Production of sufficient supporting information to support design verification and validation (V&V) against requirements – by SDS designer
- 2.4.3. Independent review of design and its associated V&V documentation – by SDS design management.
- 2.4.4. Demonstration of V&V effectiveness – by SDS project management
- 2.4.5. Where specific requisite knowledge is held by experts outwith the current SDS organisation, those experts are used appropriately by SDS to embed their knowledge within the design process from the very outset, or otherwise as early as is possible. These experts will probably reside currently within the Transdev and the TSS organisations. It is imperative that their input is used in support of achieving the documented system requirements and not as a means of inputting “preferential engineering”.

2.5. Additionally, that a risk-based approach is used to sample a small proportion (determined initially by tie’s Engineering Directorate) of SDS output by independent staff probably drawn from within the present TSS organisation. The results of this work will be fed back into the SDS Quality Management System and the independent sampling approach reviewed and, if necessary, modified by agreement with tie’s Engineering Directorate.

Tony Glazebrook

Deputy to David Crawley,
Engineering, Approvals and Assurance Director,
tie Ltd

*1 section 2.3 above is incorrect and should have read “Currently, SDS is responsible for self-assured design. tie, assisted by TSS where necessary, is responsible for design review and client decision-making on behalf of CEC and TS”. Note that this point was never in contention and at no time did tie or SDS ever claim that anyone other than SDS was responsible for the accuracy, compliance with requirements or self-assurance of design.

Appendix B

Email trail between tie and SDS relating to their Self-Assurance responsibility and content *NB: in reverse chronological order*

From: Reynolds, Steve [mailto:ReynoldsS@pbworld.com]
Sent: 08 May 2007 10:11
To: Tony Glazebrook
Cc: David Crawley; Chandler, Jason
Subject: RE: Design Assurance implementation

Tony

Thank you for the clarification. From now on deliverables will be provided as self-assured packages

Steve

Stephen C Reynolds
Director

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From: Tony Glazebrook [mailto:Tony.Glazebrook@tie.ltd.uk]
Sent: 03 May 2007 13:23
To: Reynolds, Steve
Cc: David Crawley; Susan Clark; Ailsa McGregor; Geoff Gilbert; Matthew Crosse; Andy Steel - TSS; steel_andy@compuserve.com; Chandler, Jason; Dolan, Alan; Trudi Craggs; Jim Harries (Transdev)
Subject: RE: Design Assurance implementation

Hi Steve,

For the avoidance of doubt, and ref note 4 in David's email below:

As we agreed at the SDS progress meeting on 24th April 2007, you are no longer to submit disparate design details for review. Designs are to be grouped into self-assured packages to a programme supplied by you asap.

The point that David is making is that, exceptionally and because of external process necessity, some key elements might be absent when packaging up for review; an obvious example being TTRO's. However, that should not be used as a reason for precluding the submission of an otherwise completed, self-assured package for review. Such a gap shall, of course, need to be clearly identified, together with a note that explains the process and timescale for ultimate completion.

Best regards,

Tony Glazebrook

From: David Crawley
Sent: 26 April 2007 18:30
To: 'Reynolds, Steve'
Cc: 'steel_andy@'; Geoff Gilbert; Tony Glazebrook; Ailsa McGregor
Subject: Design Assurance implementation

Steve, -To confirm our conversation today I have produced the notes below.

(Andy, -This is for your information and to inform the TSS comments below.)

I had a useful visit to the PB offices in Birmingham yesterday which confirmed, as best as can be done in a short visit, that you have in place all the building blocks required to deliver design assurance as specified in my note to you of 11 April 2007 (the system has 11/4 logged but the letter date is 13/4 - see link <https://wss.tie.ltd.uk/tram/development/Correspondence/DEV-COR-246.pdf>) or attached documents for the letter). It is clear that those I spoke to understood what was required.

The overall concept is that you will deliver design 'packages' containing logically grouped designs (in order to address interdependencies) and will add a covering statement which provides competent assurance that the design is fit for purpose. This will cover the issues identified in the checklist in the attachment and is intended to add value by ensuring that reviewers have a summary of important issues with the supporting evidence to inform their review. To deliver this in practice requires some supporting actions.

1. An important consideration in implementing this way of working is to understand what the details of the design deliverable packages will be. At present there are a large number of design elements to be completed against your programme. These elements require packaging to ensure that they appear together with associated elements (e.g. track and roads together). I need to make available to TSS an indication of how many top level packages are relevant to the detailed design stage. For example, there may be, say, 60 top level packages, each consisting of up to 5 asset groups, with each asset group containing up to 30 design drawings.
2. The base data for the design packages is also relevant to the production of the progress 'dashboard' as detailed in the attachment.
3. To cover the assurance checklist issues requires a simple pro-forma to accompany design packages in which you should indicate for each item whether or not assurance is being 'claimed'. Where it is, a reference to the location of the supporting evidence should be provided. Where it is not, statements of the issues giving rise to this should be provided. I understand that Martin Conroy is already engaged on this activity. This checklist will follow final production of the Design Verification Statement (DVS) which is part of your existing processes.
4. Notwithstanding the need to package inter-dependent designs for review, designs should still be submitted to the extant programme as individual items even though their status cannot be confirmed until after receipt of the design assurance information.
5. No change is proposed to payment against the extant schedule noting that the 20% retention could be released on successful completion of the design assurance checklist associated with the groupings of designs. This is for final agreement with Geoff Gilbert.
6. No change will be made to any current meetings or consultation processes.

I hope that we can get to a point where everything is substantially in place to deliver in the new format by Monday 7 May, and certainly not later than Monday 14 May.

In order to demonstrate successful implementation it is likely that we will subject each design package to significant scrutiny in the first instance. There will also be audits of both process and product to confirm that confidence is well placed. When confidence has been established there will be the presumption of self-

assurance with effort focused only on issues where there is no claim for an item being assured or on high risk items.

TSS will be asked to construct a review programme around these concepts which offers competent assurance to **tie** that we are receiving assured designs which are fit for purpose and which represent value for money. TSS will also work in support of **tie** in designing and conducting the audit programmes and in defining high risk items requiring detailed review.

I would be grateful for your comments and confirmation of each of these points and also a formal reply to my attached letter of 11 April.

Many thanks,

David