Industry Response Group Competences for Building a Safer Future

Working Group 01 – Engineers

Final Report version: 1.0

1.00 Engineers - membership and lead contributors

1.01 Chair: George Adams, SPIE UK, Engineering Council

Secretary: Katy Turff, Engineering Council

1.02 Lead contributors

See Annex A.

2.00 Executive Summary

2.01 WG1 brought together four end-user organisations, 13 professional engineering institutions and two other industry bodies led and supported by the Engineering Council. WG1 had good integration with MHCLG.

2.02 The scope of WG1 was the competence required by engineering professionals engaged in design, build, test and maintenance of the fixed engineering assets that constitute life safety systems within a Higher-Risk Residential Building (HRRB) and proposals for the Safety Case process.

2.03 Engineering life safety systems are critical to the safety of occupants and fire and rescue services, and buildings must be seen as an integrated solution if the integrity of the life safety strategy is to be maintained. The choice, specification and performance of each individual element of the system or collection of systems is critical to the overall safety of occupants. WG1 set out to define how the competence and professionalism to undertake these tasks could be better recognised and this included the need for improving the integration of systems and approaches.

2.04 For residents to be safe and feel safe, WG1 identified a need to integrate the currently disparate engineering practices in HRRBs and provide a new coherence to the life safety solution. WG1 has approached this from three angles:

- The engineering and safety interfaces throughout the building lifecycle, as defined by an enhanced version of the RIBA Plan of Work (Annex D), and the roles responsible for them
- The Safety Case as an integrating process and the role of the engineer in creating and maintaining it
- The existing framework of engineering professional registration, competence standards and statement of ethical principles

WG1 has:

- Identified key improvements needed and learning from other industries
- Undertaken site visits (Annex E2) to explore the operational engineering competence needed to manage and maintain the building Safety Case
- Explored and used an established methodology – Bowtie risk assessment – to analyse the key components in the life safety system and the competences needed to implement, operate and maintain them. (Annex J)

2.05 WG1 considers that problems arise during occupation, when modifications made in isolation collectively produce a material change to the way the building functions. The future approach must be capable of being deployed in existing as well as new buildings.

2.06 **Key Recommendations**

Recommendation One: Dutyholders should be required to appoint a Lead Engineer with responsibility for overall safety risk management throughout the building lifecycle.

Recommendation Two: To improve interfaces between systems and professions dutyholders should use a systematic safety management process, comprising a safety management system, safety case and a hazard identification and risk assessment methodology, coupled with engineering leadership responsible for ensuring these are integrated and functioning effectively. The proposed process needs to be user-friendly and enable collaborative contribution of stakeholders including residents.

2.07

Recommendation Three: The Engineering Council should establish a section of its Register requiring assessment and revalidation against an enhanced 'contextualised' version of the UK Standard for Professional Engineering Competence (UK-SPEC) mapped to an HRRB benchmark competence framework and process. This should include identified levels of competence from awareness to comprehensive that can be used to build competence profiles underpinned by a code of ethics and professional engineering conduct.

2.08 WG1 worked with four groups of HRRB dutyholders to test these concepts with positive outcomes. WG1 proposals are advanced enough to move into piloting the safety management process and competence framework with industry professionals.

3.00 Industry context

3.01 The biggest challenge is how to make existing occupied HRRBs, some of which were built in the 1960s, safer. *Building a Safer Future* indicates there are 2-3000[1] tower blocks in England qualifying as Higher-Risk Residential Buildings (HRRBs). Only a small proportion of these are new builds. A new system must be applied retrospectively for impact to "raise the bar" within the industry. The observations on the current industry context below reflect the collective experience of WG1 members.

3.02 **Observation One**: The process WG1 has been through has identified that there is no joined-up approach to ensuring that all services in a HRRB work together to provide a fully functioning safety solution. The requirement to integrate safety critical systems technology into all buildings is frequently not upheld. Safety cases are not used and consequently the connectivity between design, build and operate is disjointed and inconsistent.

3.03 **Observation Two**: People with responsibilities for HRRBs are not required to be familiar with the building or its component parts. The Construction (Design and Management) Regulations (CDM) (Annex I) focus on ensuring safety during construction and setting up a system for future safety but do not provide coherence in relation to the occupants of the building during the operational phase. Compliance is not regulated. The designers often are not retained beyond the design phase and the detail of designs and design calculations essential to the 'golden thread' is often not accessible or not updated. Older buildings pre-dating CDM often lack documentation including original designs and life safety strategy.

[1] BSF para 1.3 (p19) and Appendix C

3.04 **Observation Three:** In all buildings there will be a multitude of life safety engineering systems to be designed, built, tested, modified or new systems added and there needs to be a fully integrated life safety engineering solution. Under CDM regulations it is both permissible and the norm that the Principal Designer (Annex I) is not the lead designer. Where extensive use is made of sub-contracting, procurement can create separate work packages, creating separate systems within the same project. Unless required by contract, contractors responsible for 'contractor-designed' portions are not obliged to demonstrate design competence and the lead designer is not obliged to verify the competence of sub-contractors who undertake design work.

3.05 **Observation Four:** Where undertaken, change management processes are not sufficiently robust to deliver life safety systems.

3.06 **Observation Five:** To improve competence, behaviours and responsibilities within the Built Environment Industry at all levels, its largely blame and 'cheapest price rules'[2] approach needs to be led into a culture of identifying and analysing data related to failures to identify systemic issues and make focused reforms to achieve safer and more efficient buildings.

4.00 Responding directly to questions arising from Dame Judith Hackitt's recommendations

4.01 WG1 has considered: definition of buildings in scope (1.1, 2.4); treatment of the building as a system (1.3); key roles (2.1), creation, maintenance and handover of key documents (2.3) use of safety case (2.9, 2.14, 3.3); engagement with residents (4.1), industry leadership (5.1), overarching competence system and overarching competence framework (5.2), products (7.1), golden thread (8), contracts and procurement (9.1-3).

5.00 Issues and recomendations

5.01 Issue 1: Interconnectivity of building components

5.02 To function in accordance with codes, practices and approvals all the components should be designed, built and operated in such a way as to complement one another. This includes the structure, the building envelope, the services, fixtures and fittings within the building and its relationship to adjacent buildings, other infrastructure and the natural environment. These components must be considered as an interconnected whole in order to maintain the safety and functionality of the building and its occupants. This interconnectivity must be maintained throughout the life of the building.

5.03 Design should include a life safety strategy aimed at preventing harm and protecting occupants and emergency services in the event of a potentially harmful incident. WG1 identified that to raise the bar it is essential to increase the rigour and coherence of engineering responsibility for and integration of technology. This requires engineering leadership during design, build and testing and engineering support during the operational and maintenance phase.

5.04 **Recommendation One**: Dutyholders should be required to appoint a Lead Engineer with responsibility for overall safety risk management throughout the building lifecycle.

5.05 WG1 concluded there is a requirement for a Lead Engineer (Annex D) throughout the building lifecycle with the responsibility, authority and competence to ensure that the building as a system is being engineered appropriately and the safety systems always function as intended.

[2] A Better Deal for Public Building, All-Party Parliamentary Group for Excellence in the Built Environment 2012

5.06 During design and construction, the Lead Engineer should take an integrated view of the building and manage the co-ordination of the many complex engineering parts. During the much longer period of occupation, maintenance and from time-to-time renovation of the building, the Lead Engineer should be an independent advisor to the Building Safety Manager. During the preparation and submission of the Safety Case the Lead Engineer should act as an Independent Competent Person, fulfilling an audit function.

5.07 All engineers, co-ordinated by the Lead Engineer, must recognise their shared responsibility to ensure that all sub-systems of the building contribute to the safety of the whole. The Lead Engineer should be competent to lead and evaluate the effectiveness of that "systems thinking" on the part of the team. Timescales and the need for different engineering specialities may mean a company rather than a natural person is needed.

5.08 **Issue 2: Creating a Safety Case for HRRBs**

5.09 In the nuclear and process industries, aviation and rail sectors, a safety management process comprising a safety management system, safety case, hazard identification and risk assessment techniques and the use of suitably qualified and experienced persons is established and effective practice. This process is well known to the engineering community. Risk assessment is part of risk management. The Health and Safety at Work Act requires that risks are managed/controlled to be as low as reasonably practicable (ALARP). Safety Cases are also used for sports stadia, airports and railway stations. However, they are not used in the residential building sector.

5.10 A safety case is an assessment of an object that is used by people with respect to the health and safety of those using said object. In terms of HRRBs, the building is the 'object' and its occupants are the 'users of said object'. This abstract view of buildings is not commonly held but it is important as considering the building as a whole is vital for producing an all-encompassing risk assessment that would ensure it is safe to use.

5.11 Each industry which has adopted a safety management process, usually following a major disaster, has had to adapt the process to its particular needs. WG1 spent some considerable time working to understand how HRRB Safety Cases could be prepared and presented. This included visits to existing occupied HRRBs and discussions with building operators where the concept of the Safety Management Process was well-received and further trialling was agreed.

5.12 **Recommendation Two**: To improve interfaces between systems and professions dutyholders should use a systematic safety management process, comprising a safety management system, safety case and a hazard identification and risk assessment methodology, coupled with engineering leadership responsible for ensuring these are integrated and functioning effectively. The proposed process needs to be user-friendly and enable collaborative contribution of stakeholders including residents.

5.13 Risk is a function of the likelihood and consequence of hazards. The HRRB safety case must cover all risks. In order for a safety case (and its processes) to be approved, the building owner/operator will need to have in place a safety management system (SMS) to demonstrate that the required inspections such as the Fire Risk Assessment, life safety systems inspection and the various regulatory inspections have been carried out and documented, and any non-conformities found and recommendations made are addressed. WG1 found that some building operators use asset management systems and/or housing maintenance management software to track building work that might be modified for this purpose.

5.14 A key part of any safety case is the underlying hazard identification and risk assessment. Building owners are familiar with fire risk assessments as these are a legal requirement. The proposed safety management process (Annex E1) needs to be user-friendly and enable collaborative contribution of stakeholders including residents. WG1 identified the Bowtie risk assessment method

(Annex J) as one that, if used appropriately, enables collaboration across all stakeholder groups to provide comprehensive insight into the safe operation of the building. The Bowtie identifies the interaction between the essential life safety systems (such as smoke vent, fire alarms, fire compartmentation, sprinklers etc) and demonstrates the safety interdependencies and compliance requirements at all stages of an HRRB's lifecycle.

5.15 The safety management process can enable everyone across the Industry to be aligned to the HRRB safety needs and identify the minimum level of understanding needed to interact with, for example designers, procurers, constructors, testers and maintainers and the eventual Building Safety Manager (BSM).

5.16 **Issue 3: Competence of construction professionals and operatives**

5.17 There is no legislative structure in the UK to ensure that engineers who practice are qualified. HRRB operators encountered on site visits were seen to know their jobs, be competent and committed but must work in the environment and system they are in. The collective experience of WG1 concluded that Industry does not fully embrace the skills, knowledge, behaviours, experience and coherence required when appointing engineers to roles in HRRBs.

5.18 The Engineering Council is the regulatory body for the professional engineering institutions and holds the UK national Registers of Chartered and Incorporated Engineers, Engineering Technicians and ICT Technicians. The Engineering Council sets profession-wide generic engineering competence standards, including learning outcomes used for the accreditation of engineering education programmes, which the institutions tailor to a greater or lesser extent for their disciplines. Bodies from non-engineering disciplines provide similar guidance. However, none of these address HRRBs as a unique building form, therefore these frameworks do not specifically focus on life safety or the issue of integrated design, construction and operation methods that are critical for HRRBs.

5.19 **Recommendation Three**: The Engineering Council should establish a section of its Register requiring assessment and revalidation against an enhanced 'contextualised' version of the UK Standard for Professional Engineering Competence (UK-SPEC) mapped to an HRRB benchmark competence framework and process. This should include identified levels of competence from awareness to comprehensive that can be used to build competence profiles underpinned by a code of ethics and professional engineering conduct.

5.20 To take on a discipline role within an HRRB project, at any stage in its lifecycle, requires demonstration not only of competence but also of commitment to the systems thinking and shared responsibility that goes with it. WG1 considers that the Engineering Council's generic Standard for Professional Engineering Competence (Annex G) and Statement of Ethical Principles[3] (Annex H) provide an appropriate baseline from which to develop specific and enhanced competence requirements that also map to an overarching HRRB competence framework. WG1 further considers that those assessed as meeting the enhanced competence requirements should be admitted to a contextualised section of the Engineering Council Register with prescriptive CPD and revalidation requirements aligned to other professions within the overarching competence system.

5.21 WG1 proposes that contextualised registration would require membership of a professional engineering institution that can provide appropriate support for and monitoring of continuing professional development and conduct, investigate complaints and impose sanctions when needed. Assessment and revalidation would be carried out by Professional engineering institutions licensed by the Engineering Council. Professional engineering institutions would be able to apply for a licence extension to assess individuals for admission to the contextualised HRRB register.

[3] Developed and published jointly with the Royal Academy of Engineering

Contextualised engineering competences (Annex F1, F2, F3) relate to:

- Application of knowledge and understanding of performance of the building as a system
- Principles of fire science, fire and life safety
- Boundaries of competence and interfaces with other disciplines and professions during design, construction and operation of buildings
- Knowledge of building regulations, standards, management systems and certifications
- Safety Management Process including Safety Case review
- Integration of engineering components within a building system

5.22

Enhanced generic engineering competences relate to:

- Hazard identification and risk assessment
- Engaging and communicating with stakeholders including residents
- Use of construction products
- Promoting a culture of ethical behaviour, based on the four key principles of the Statement of Ethical Principles

6.00 Programme for delivery and primary authorities

Industry alignment by December 2019 as a fast track target. It is recommended that compliance is mandatory, and a mandatory implementation time scale is also agreed in parallel with the Competence Steering Group and MHCLG consultations.

WG1 proposed actions:

6.01

- Safety case second workshops with 3 of the 4 user groups (September 2019)
- Final proposals for safety case process (November 2019)
- Finalise Lead Engineer role with representative industry bodies, with requirement to appoint to be introduced in line with implementation of the new legislation (November 2019)
- Finalise SMS proposal and competency matrix (December 2019)
- Finalise concept for a training program that will be required and parties to deliver it (2020)

6.02 Primary Authorities for engineering are the Engineering Council and those professional engineering institutions opting to provide a route to the contextualised HRRB engineering register.

7.00 Barriers to delivery

7.01 Industry's willingness to re-structure to adopt new roles and practices for what is a narrow slice of the market. Government needs to set out that the changes will not stop at HRRB's in the long term.

7.02 The introduction of an enhanced competence framework is unlikely to have significant impact while the use of competent engineers remains optional. Guidance supporting the new regulations should set the expectation that dutyholders will appoint suitably qualified and experienced people, as demonstrated by inclusion on a contextualised register.

7.03 The changes are unlikely to be widely adopted unless sanctions are in place to ensure industry compliance, including a resourced compliance/auditing capacity. This must be coupled with structured compliance training opportunities. Government should initiate a strong drive for change and at a momentum commensurate with the risks.

7.04 Further development of the concepts, pilot studies and guidance materials will be needed, together with sufficient competent training providers, to ensure a ready to play solution is made available.

7.05 There is a serious shortage and diminishing supply of skills in the industry (Brexit is not the driver of this). HRRB's new requirements will add to the industry's demand at a time when other sectors,

such as cyber security, are targeting the same resource pool.

7.06 Lack of joined-up support for the need for the Lead Engineer role at Steering Group level

8.00 Acknowledgements

Thanks are due to all working group members listed in Annex A for their engagement and contributions.

8.01 Thanks also to Southwark Council, Camden Council and Haringey Council for hosting site visits and positive engagement with this work, and to Sheryl Hurst of Risktec for her introduction to Risk Assessment and Bowtie.

The generous support of Aecom, Engineering Council, Institution of Structural Engineers, Institution of Mechanical Engineers and SPIE UK in hosting meetings is also acknowledged.

9.00 List of Annexes

Annex A – Working Group membership and companies
Annex B – Barriers to Delivery
Annex C – Engineering roles and interfaces with reference to RIBA Plan of Work
Annex D – Lead Engineer role description
Annex E1 – Safety Management Process
Annex E2 – Site Visit Reports
Annex F1– Contextualised competence guidance
Annex F2 – Contextualised competences
Annex F3 – Competence system diagram
Annex G – UK-SPEC
Annex H – EngC/RAEng Statement of Ethical Principles
Annex I – Principal Designer in CDM Regulations
Annex J – Bowtie Analysis – Fire in HRRB prepared for Engineering Council by Sheryl Hurst, Risktec Solutions Ltd, 2018