



Nuclear new build

# Greenfield Site to Power Generation

Adding value throughout

**ConstructEnergy**



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**ConstructEnergy** is a joint venture specifically formed to provide support for the developers of new nuclear power stations in the UK. The joint venture companies offer a wealth of experience and capability with a strong financial position.

**Sir Robert  
M<sup>c</sup>ALPINE**

Sir Robert M<sup>c</sup>Alpine's experience ranges from the UK's original fleet of nuclear power stations, through a continued presence at Sellafield since 1983, to our current work to support a new generation of reactors. Our track record also includes the entire civil, structural and architectural design of 13, and the complete construction of 6, of the UK's current fleet of nuclear power stations. The company has a full design & build civil engineering and building capability and can cover the full range of services across the entire lifecycle of nuclear facilities.



Costain is one of the UK's leading engineering solutions providers, delivering integrated consulting, project delivery and operational services across a broad range of infrastructure sectors. The company is one of the largest providers of engineering services to the UK nuclear market and has recently been involved with some of the UK's largest nuclear projects.



Hochtief is one of the largest international construction groups worldwide. The Group operates in the transportation infrastructure, energy infrastructure and social/urban infrastructure sectors as well as in the contract mining business. Hochtief has practical expertise in the whole nuclear life-cycle, from planning and the execution of construction, to maintenance, improvement works and decommissioning. This includes the planning of all German reactor buildings with boiling water and advanced reactors.



Heitkamp Ingenieur-und Kraftwerksbau GmbH is one of Germany's leading constructors of nuclear power plants and cooling towers, and embodies an optimum combination of engineering know-how and construction realisation experience. Heitkamp has been involved with the construction of the world's first EPR™-reactor in Finland and has vast experience in constructing turbine halls.

# Greenfield Site to Power Generation

## Site delivery

We can add value at every stage, coordinating the many disciplines involved in the delivery of nuclear plants

### Our strengths, skills and capabilities:

- Planning and programming of multi-discipline, multi-year processes
- Ability to provide full regulatory and licensing support
- Site preparation, logistics and enabling works
- Best in class approach to health, safety & environment
- Robust quality control to guarantee compliance of the end product
- Construction management experience from many large-scale projects
- Full understanding of equipment installation
- Teamworking throughout the project

Effective on-site management of all disciplines involved in nuclear power station delivery is essential to secure the earliest possible start to power generation and minimise investment costs.

From arrival on site, through construction, commissioning and beyond, we provide the site-wide continuity that is key to delivering this revenue stream as efficiently as possible.

### Site Delivery

Preparation of programmes, even with contractual commitment, is no guarantee of performance; schedules slip and delays in one area can result in ever larger and more costly hold ups elsewhere.

What is required is a project partner who combines a strategic approach with an unremitting focus on the practicalities of day-to-day delivery.

As main contractors we have extensive experience in managing large numbers of subcontractors to tight programmes and recognise the critical importance of developing close relationships. It is an approach which allows us to develop a deeper project understanding and a full appreciation of the challenges that each

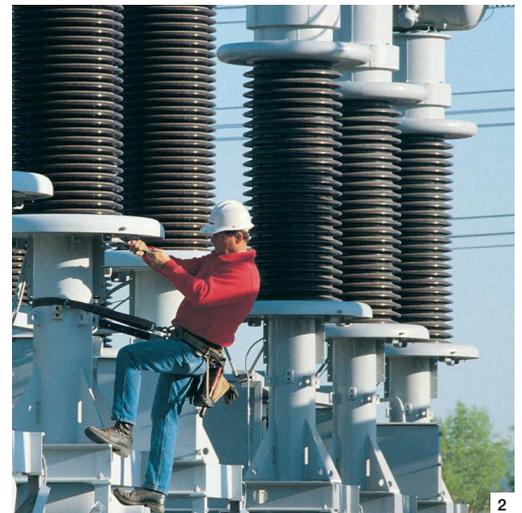
supply chain partner has to address. This in turn allows us to ensure that each company understands the interfaces with their part of the works, and the real consequences of failing to meet the agreed outputs. We have found that this personal contact proves hugely effective in managing and motivating teams on site.

It is an approach which must be underpinned by robust project controls and project documentation control. Quality control and the extremely high audit trail standards necessary for nuclear projects will be more readily achieved through the development of cohesive and enduring site relationships.

In our experience the earlier our involvement, the greater the increased continuity and depth of project knowledge we are able to bring to the process. These are factors which can prove of immeasurable value to our clients.

To illustrate the benefits such continuity can deliver, we have set out on the following pages the value we can add at each stage of the project development process on site...

1. Hinkley Point B – one of six British nuclear power stations where we carried out all the civil engineering construction and design.
2. Construction processes must integrate with all the other disciplines needed to deliver the project.



# Planning and Programming

## Planning ahead for quality construction

Detailed planning of the diverse disciplines involved in constructing a nuclear power station is essential to meeting cost and programme goals. Time invested in optimising a programme which takes into account the opportunities and threats for all parties, and finds ways of mitigating risks and speeding execution, always delivers dividends.

Our team has the in-house skills to provide this comprehensive service. Its members bring with them experience acquired on projects such as the design and construction of Sellafield's new Evaporator D, construction of the main EPR buildings for Olkiluoto 3 in Finland, the design of the UK's first Pressurised Water Reactor at Sizewell B, and Niederaußem power station in Germany which boasts the largest cooling tower in Europe. Members of the team were also brought in to improve site management on the Olkiluoto project in Finland.

We have experience of managing programmes in both a proactive and reactive way. We are able to manage unforeseen delays and keep the programme on track as well as look ahead to identify potential delays and put in place mitigating measures to prevent or reduce their impact. We have found that an open and inclusive approach

to communications optimises project understanding and an appreciation of the programme parameters among all parties, resulting in improved overall efficiency.

With our extensive construction experience and knowledge of nuclear regulation, we can provide advice to the developers from an early stage and work with them to assess potential programme and project risk to devise mitigation or even avoid key challenges. Working together we can develop feasible programmes and a safe working environment with robust and auditable cost estimates. This can be key in convincing funders for the construction phase and provide the Regulators with added confidence.

Understanding and coordinating the requirements of all project partners is key to successful delivery



3. Working with our clients we examine the opportunities and threats faced by all parties and work with them to mitigate risks and speed programme execution.

4. On the Olkiluoto EPR in Finland we were brought in to help resolve site management problems, using our major project experience to coordinate the various interfaces.

# Design Support

Better built by design

We have the expertise to resolve the many design challenges that nuclear power plants involve

**We have all the skills required to design new nuclear plants, including:**

- Civil & structural design and analysis
- Safety cases
- Geotechnical engineering
- Permanent & temporary works design
- Seismic design
- Architectural design
- Intelligent/informed customer support
- Environmental and sustainability compliance
- Compliance testing & building pathology
- Collaborative working
- Concrete recipes
- Reinforcement and embedments

The Generic Design Assessment (GDA) is identifying site-specific design issues such as seismic design, cooling water and compliance with planning consents.

We use our substantial design experience and the constructability lessons we have learned on a variety of nuclear and non-nuclear facilities, to improve cost and programme, especially in relation to site-specific designs.

Different codes of practice and conversion from British to metric units bring issues we successfully resolved when we carried out the design of Sizewell B.

Our highly experienced in-house nuclear design teams number around 300 strong. We designed the complete building and civil engineering works for 13 out of 17 of the British nuclear fleet. We were closely involved in 23 out of 24 of the German fleet and several others around the world (see page 15).

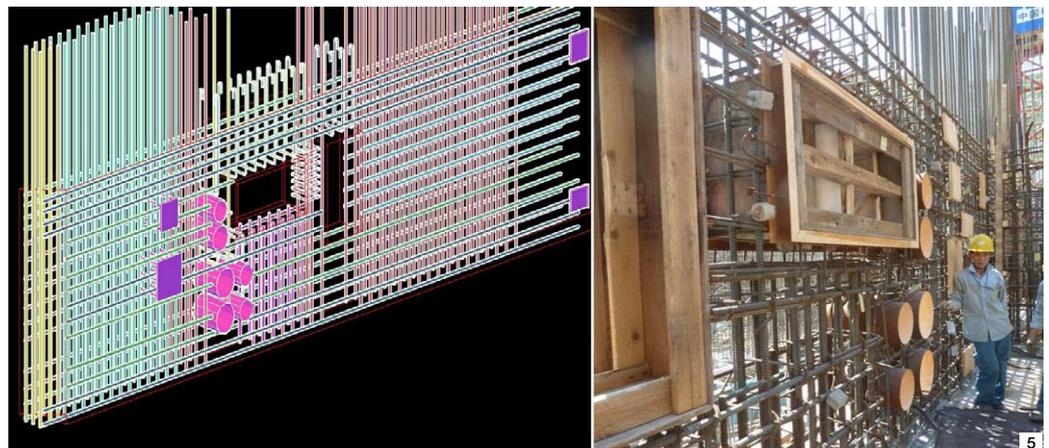
We have maintained and enhanced our nuclear design skills since completion of Sizewell B, the last nuclear power station we designed in the UK, through continuous work on and within other nuclear facilities:

- supporting British Energy in the maintenance of its fleet
- operating in the majority of UK and German nuclear plants
- advising and designing at major nuclear facilities such as Sellafield
- participating in industry working groups

We resolve site queries and design temporary works and advise on large-scale operations such as the big dome lift at Olkiluoto.

Concrete is one of the most critical construction materials for nuclear power plants. We are able to provide in-house knowledge in concrete technology implementation for the nuclear sector based on decades of experience. We have particular experience in developing nuclear concrete 'recipes' which have the required characteristics to meet the exacting requirements of nuclear structures.

5. Wall reinforcement and embedments need to be fully detailed to present to the Regulator for approval and implemented exactly as modelled for nuclear related structures.



# Regulatory and Licensing Support

Building on our experience

British requirements differ from those elsewhere in the world, whether regulated by the local Environmental Health Officer, the local authority or the Nuclear Directorate. Our many years of working for and dealing with regulatory bodies, examining and assessing submissions and safety cases, means we can help avoid some of the potential pitfalls and smooth the resolution of the inevitable difficulties.

We have knowledge and experience of both national and international nuclear Regulators. This includes working directly with:

- The Office of Nuclear Regulation (ONR), the Environment Agency and Marine & Maritime Organisation (MMO) as well as making submissions to them
- Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), Aufsichtsbehörden in Germany
- The International Atomic Energy Agency, and the US National Regulatory Commission internationally

We are familiar with the different design codes used internationally, in France, Germany, Finland and the USA, their evolution over time, and the nature of the detailed discussions with the UK regulators

to reach a resolution for their application in Britain. For example, we played a key role in producing the 'Anglicised' and metric version of the US concrete design codes that were used on the Sizewell B PWR project (ASME boiler and pressure vessel code for containment design and ACI 349 for nuclear safety related structures).

Adhering to the precise implementation of designs and the exact requirements of the specification is vital, as is collating the appropriate project documentation to demonstrate that this has been achieved. We employ Suitably Qualified and Experienced Personnel (SQEP) in many disciplines, and have, over the decades, established strong relationships with a highly skilled supply chain.

We have been providing support to the ONR in undertaking condition assessments of the Magnox fleet of nuclear power stations and have developed project safety cases for plants on the Sellafield site.

We can help to ensure a smooth passage through the regulatory and licensing system



6. Clients benefit from the regulatory and licensing system experience we have acquired on a variety of projects such as the design and construction of Oldbury power station.

7. Through constructive engagement with the Regulators the safety case for the Evaporator D project at Sellafield took just 100 days to go through nuclear regulatory approval.

# Site Preparation, Logistics and Enabling Works

Providing comprehensive site expertise

We have the skills and experience to manage the many challenges that projects of this scale and complexity present

There will inevitably be significant space constraints on the site, with many competing demands for laydown, lifting, secure storage and working areas.

We therefore propose, based on our experience of other nuclear power sites and many complex multi-discipline projects, that we are responsible for all site logistics because we understand the needs of all the parties. We will manage security, deliveries to site, allocation of areas of the site, and the manoeuvring and craneage for large modules and items of plant.

To prepare the site for this complex level of activity and enable each supplier to work effectively from the moment they arrive on site, a large amount of enabling works will be required, such as earthworks, retaining walls, railways, roads, drainage and provision of welfare facilities. This is an activity we carry out on all our sites and can readily apply to a new nuclear power plant.

8. Understanding the requirements of all parties is crucial to effective on-site management.

9. Tunnels can bring critical interfaces, as here on the Margate and Broadstairs UWWTD Scheme.

10. Earthworks and site excavations must be completed quickly once DCO is granted.

11. Jetties such as Belverdere can provide for delivery of materials and plant.

Delivery of modules and bulk materials to the construction site by sea is essential as the available nuclear sites in the UK are located in remote areas where road access is often constrained. We can provide advice and guidance on the planning and construction of jetties and Marine Off-Loading Facilities (MOLFs).



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# Health, Safety and Environment

Our goal is a workplace free from harm

We are committed to the highest standards of health and safety and environmental performance. Our processes and performance levels are at the forefront of the construction industry, and we have developed the knowledge and skills to implement world-class environmental and health and safety plans which are fully compliant with the requirements of individual nuclear site licenses and deliver benefits in terms of sustainability.

Health, safety and environmental management must take into consideration the entire life cycle of the plant from design and construction through commissioning and operation to its eventual decommissioning.

We strive to ensure that all personnel go home safe and healthy at the end of each day. We not only endeavour to minimise our impact on the environment but seek to enhance it. Although incident trends continue to decrease our goal continues to be to achieve zero harm.

The UK-specific code of practice for nuclear sites has been fully embedded in our operational systems through working closely

with the Office of Nuclear Regulation, and the Environment Agency; this is demonstrated through our current ongoing and recent experience at:

- Sellafield
- the Magnox reactors being decommissioned
- the EDF Generation fleet of operating plants
- Olkiluoto 3 plant under construction in Finland

Our projects are regularly recognised with awards from safety organisations such as the Royal Society for the Prevention of Accidents (RoSPA).

In December 2011 we became the first organisation in the UK to have its behavioural safety programme accredited by an independent third party, The Cambridge Centre for Behavioural Studies. The programme was re-accredited in 2015.

Safe behaviours by everyone, protecting the health of all and enhancing the environment we work in are the core values of how we operate

## Health and Safety Awards

**2 Order of Distinctions (15 yrs Gold Performance)**

**2 President's Awards (10 yrs Gold Performance)**

**2 Gold Medals (5 yrs Gold Performance)**

**25 Gold Awards**

**Astor Trophy Special Award for best management of occupational health**

**2 Silver Awards (RoSPA)**

**1 Gold Award (RoSPA)**

**2 British Safety Council – International Safety Awards**

**Several Health and Safety Awards – AREVA and Siemens**

**Our approach to health, safety and the environment provides the following benefits:**

- Construction partners for whom health and safety and minimising environmental impact are core values
- Committed and visible leadership team
- Rapid, responsive, and high-quality fully-open investigation and reporting
- A well-established behavioural based safety process
- Commitment to environmentally sustainable solutions
- Strong environmental management of ecology, pollution and waste

# Quality

Right first time

Robust and auditable site-wide quality controls must be established from the outset and managed appropriately

The quality of all aspects of nuclear construction and installation must be of the highest standard. It must also be demonstrated to be of the highest standard by a rigorous audit trail.

To deliver the quality of works new nuclear projects demand, quality control procedures will be established that are robust, auditable and managed appropriately to the services provided. This is a crucial element in the successful delivery of these projects.

Our process for managing and reducing defects is based on our 'right first time' culture. We promote quality awareness and ensure the commitment of all parties to the standard of construction required through our established quality controls and procedures.

Through our culture of surveillance and audit, inspection and testing, both on and off site, we ensure all required criteria are met. We apply international standards such as ASME to our own work and that of our supply chain.

We will ensure that quality is tightly controlled within our supply chain through the use of a fully integrated quality management system which is significantly more stringent in its requirements than the ISO 9001 standard to which we are certified. This approach will also ensure quality is maintained at interfaces through rigorous procedures which will reduce rework to the very minimum.

Adopting a systems engineering approach will help to capture requirements at the design stage which can be demonstrably satisfied at the verification phase. We are leading the introduction of requirements management for nuclear facilities in the UK through the International Council on Systems Engineering (INCOSE).

## To ensure the highest standards of quality:

- We have the right people, right experience, right skills and right behaviour
- A 'right first time' culture is embedded in everything we do
- We will use lessons learnt from similar projects to optimise performance
- We integrate the quality systems of our supply chain
- Our robust quality controls will manage interface issues between trades/activities
- Non-conformances will be closed out as work proceeds to deliver zero defects at handover

12. Behavioural-based quality is demonstrated by the publication of our 'Avoiding Common Defects' booklet. A survey suggested that it has helped to avoid up to £1.5m per year defects on site.

13. The documented audit trail is vital.



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# Total Support Services

A positive impact on local communities

To increase efficiency on a project, it is standard working practice in the UK to provide support services in addition to the main construction activities.

Over the years we have found that engagement with the local community before and during construction is of enormous benefit. As well as instilling a sense of ownership in the project among the community, it enables us to respond to their issues before they become problems.

A construction project of the size of a new nuclear power station requires thousands of workers. Our intention is to train and employ as many of the local community as are available, creating long-term opportunities through the development of a skilled workforce.

Construction of the accommodation facilities also provides an opportunity for local people to learn construction trades ahead of the main construction, so enhancing their chances of securing long-term, high quality employment.

Once the construction activities are finished, the high quality accommodation camps with restaurants, bars and recreational facilities can offer a lasting legacy for the community.

In addition to the cleaners who will be required throughout the project, there is also a need for industrial cleaning as it is safer and more cost effective to have trained cleaners rather than skilled operatives undertaking the necessary cleaning operations. Good quality catering is key to ensuring a happy and effective workforce. We can provide a pleasant, stylish and relaxed environment in which the workforce can enjoy a varied range of nutritious meals which offer excellent value for money.

The catering required for the large numbers of personnel on site also provides an opportunity for local farmers/suppliers to sell their produce.

Our aim is to establish and maintain a safe and healthy working environment for all. It is essential that support is available to the workforce on site and in the accommodation facilities. This includes the provision of medical staff and health experts to advise on health issues and lead healthy living campaigns.

We can manage the total support services required including all of the above as well as other services such as property management, logistics and security.

The facilities we provide our staff can deliver long-term benefits to the surrounding communities



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14 & 15. We can provide the high quality accommodation that will get the best out of the workforce and strengthen community relations.

# Construction

## Demonstrating compliance

Our procedures for ensuring all construction is compliant and fully auditable are currently in use on a number of UK nuclear projects

**We can manage the construction of new nuclear power stations involving:**

- A workforce of between 3,000 – 4,000 men at peak
- Concrete volumes in excess of 250,000m<sup>3</sup>
- Regular pours of 3,000m<sup>3</sup> plus
- Fabrication, delivery, assembly and installation of structural and equipment modules weighing up to 1,000 tonnes
- Coordination of the construction and installation within a relatively small footprint

Construction must be 100% in accordance with the approved drawings and specification. This fundamental prerequisite must be achieved, and be seen to be achieved by the regulators, through a rigorous process of surveillance, audit and documentation so that each step of the way is recorded.

Our procedures for method statements, inspection and test plans, briefing of operatives and all the other requirements for nuclear grade construction are currently being implemented on a number of successful European nuclear projects. We employ a wide range of operatives and staff who are recognised as SQEP – Suitably Qualified and Experienced People – and we have the training methodologies and capacity to extend this level of expertise to the much larger workforce that new build requires.

A programme of this magnitude demands a leadership team with the vision, strategic insight, experience and willingness to work openly in full collaboration with all stakeholders, designers, subcontractors and suppliers to guarantee the successful delivery of the project. We have repeatedly demonstrated our ability to fulfill this remit on previous nuclear plants in many countries, and on other major nuclear and non-nuclear projects.

There will be a substantial specialist supply chain working within the plant as it is built. We will engage with the supply chain at the earliest opportunity so that their skill, knowledge and support can be integrated into the team for the benefit of the project as a whole. We are accustomed to working in multi-discipline relationships where technical solutions are essential to the incorporation of high technology processes.

We recognise that a reliable and robust programme is essential and can only be established with the preparation of a very detailed, logically structured and integrated design, procurement and construction programme that allows for multiple “What if...?” scenarios and will continually identify the optimal programme options. Daily and weekly reviews made against this baseline programme will continuously measure improvements and highlight potential delays at the earliest opportunity to enable mitigation measures to be successfully put in place.

Civil engineering construction must advance in step with the equipment and plant installation...

16. Our supply chain partners provide essential parts of the solution. We brought the same design and build team from Arsenal's Emirates Stadium to the London 2012 Olympic Stadium to great effect.



# Equipment and Module Installation

## A coordinated approach

Successful delivery relies on the effective coordination and installation of large prefabricated modules and pieces of equipment. These frequently require very large cranes for their installation. Steam generators, for example, can weigh over 500 tonnes. The timing of the arrival, temporary storage and lifting of such equipment, and the organisation of the craneage, requires careful management to determine the most economic and time-efficient construction method.

Construction and plant installation must go hand-in-hand as the larger plant can only be installed at certain stages in the process. Additionally, in order to build the plant efficiently, all the mechanical, electrical and civil elements of the power station must form part of this coordinated approach. Craneage, for example, will be required by almost every discipline although their individual requirements in terms of lifting capacity, reach and time required on site will vary. We will implement the site-wide plan which is needed to optimise the equipment and plant installation.

We pioneered the use of modular construction for the UK nuclear market on the Evaporator D project at Sellafield and have proven the safety and quality advantages of this method.



Modular construction with off-site fabrication can allow for parallel working which reduces the overall project programme



17. Lifting and installation of structural steel modules.  
18. Modules for Evaporator D being off-loaded after delivery by sea to Sellafield.  
19. Power station jetties such as the one at Belvedere provide for plant and materials access as well as long-term operational use.

# Commissioning to Power Generation

Facilitating the process

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We will actively support commissioning to help you achieve your project goals

The commissioning and handover process will require the coordination of many work elements. It may also include minor construction work to facilitate mechanical, electrical, control and instrumentation activities around the site, requiring detailed knowledge of the plant as built.

Our continuity of involvement throughout construction and installation will ensure a familiarity with all aspects of the plant which will assist in this process. It will also help instil confidence in the regulators.

We will work in partnership with you to optimise the final commissioning in order to achieve the project goals.

Finally, a key deliverable for all parties involved in the construction is the package of 'Lifetime Quality Records' which provides the auditable trail of evidence which underpins the case for safely operating the reactors.

By maintaining our involvement from 'Greenfield Site to Power Generation', ConstructEnergy can assist the developers in providing continuity throughout the project, working in an integrated manner with other trades and contractors to ensure that the plant is built safely and successfully.

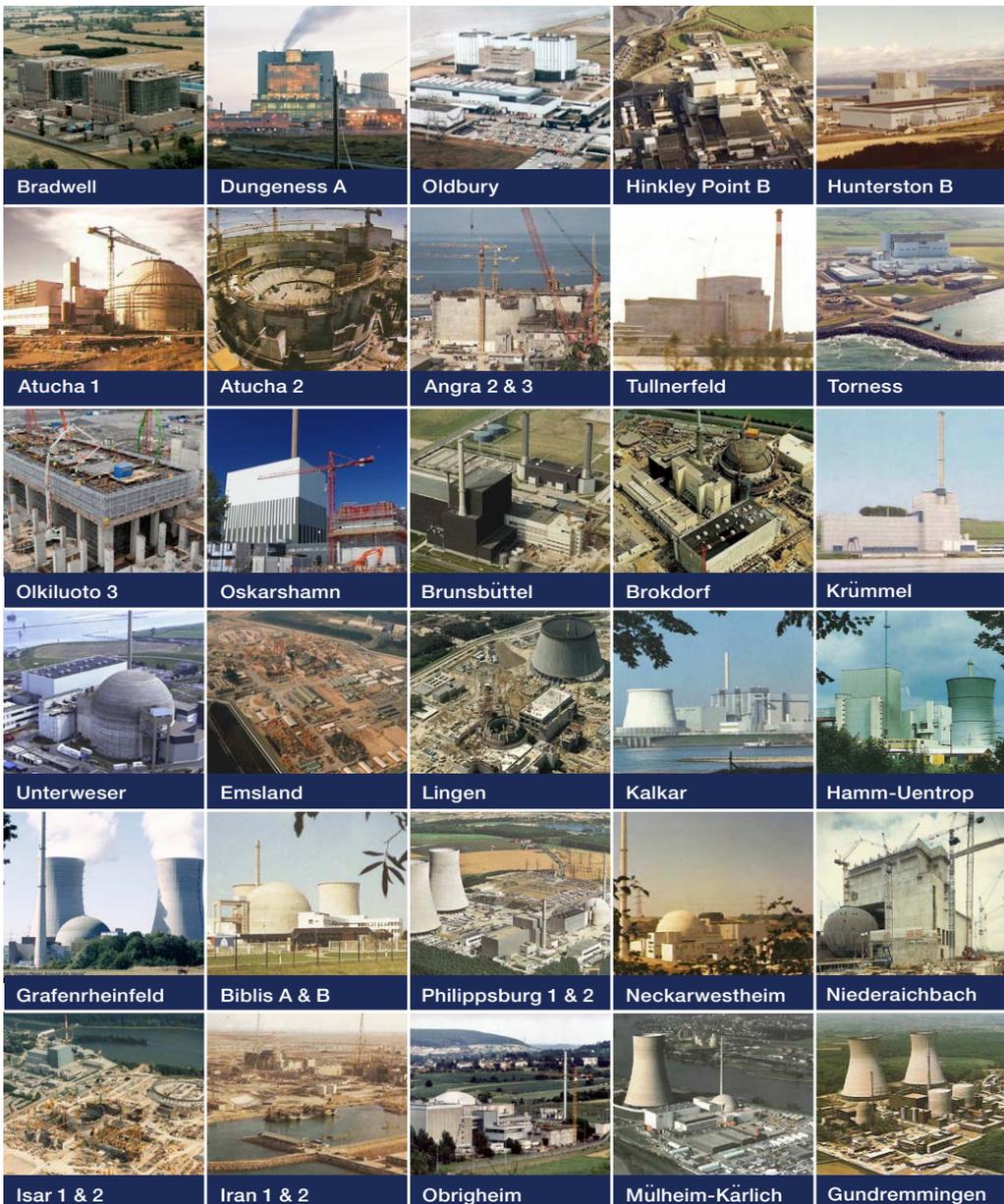
20 & 21. Following construction we'll work with you to ensure the successful distribution and delivery of the energy that powers our homes and cities.



# Summary of Experience

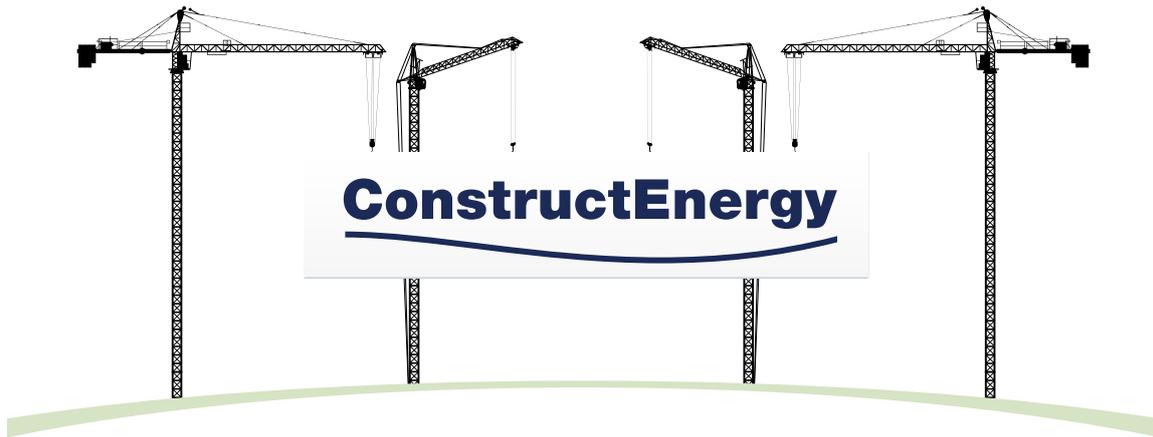
ConstructEnergy offers unmatched capacity, expertise and experience

- Over 400 years' combined experience in the design and construction of major process developments in the UK, Germany, France, Finland, Argentina and Brazil.
- Access to over 300 nuclear technical design and construction experts.
- The financial standing of an organisation with an annual turnover in excess of €40 billion.





**Sir Robert  
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