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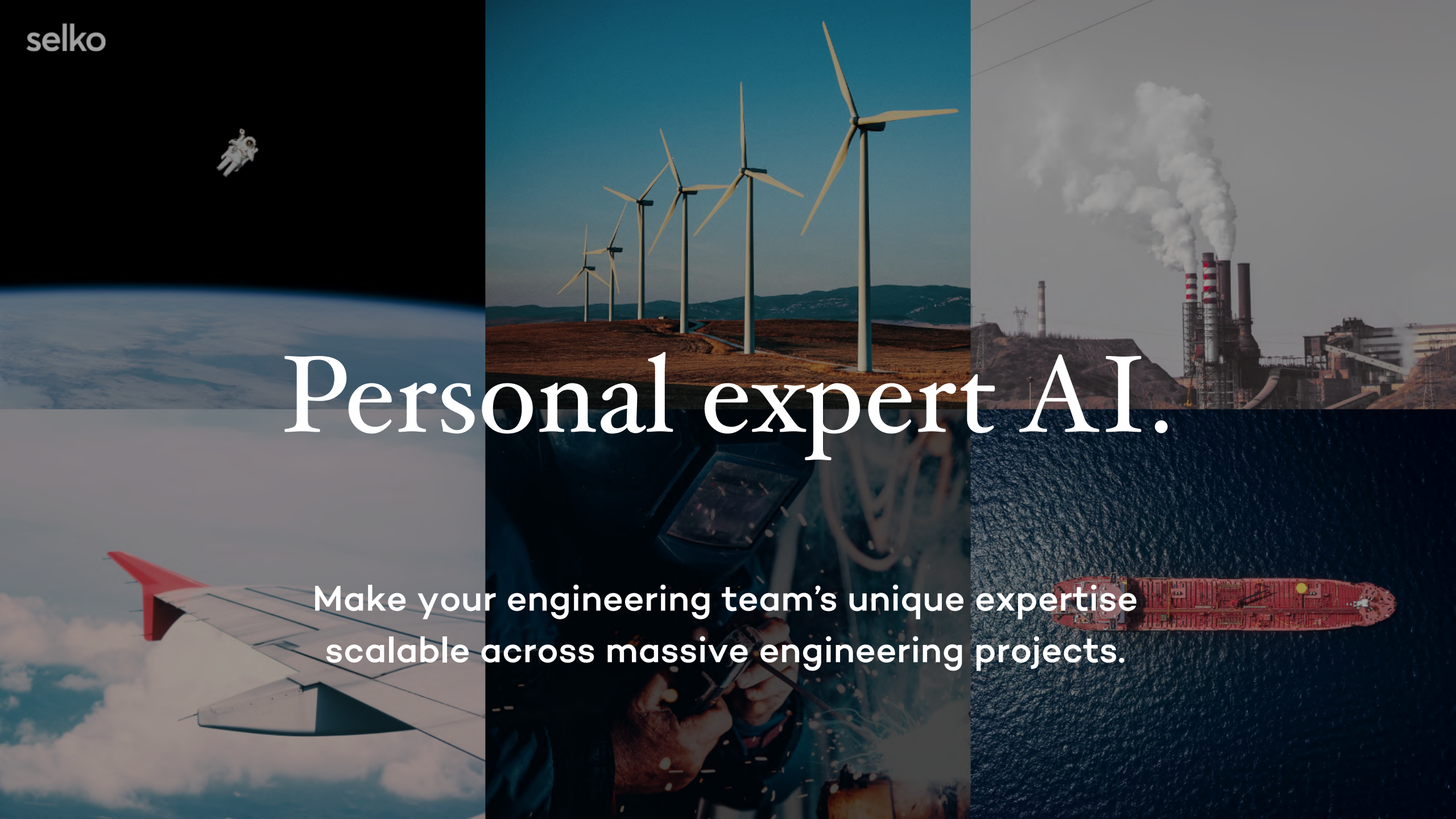
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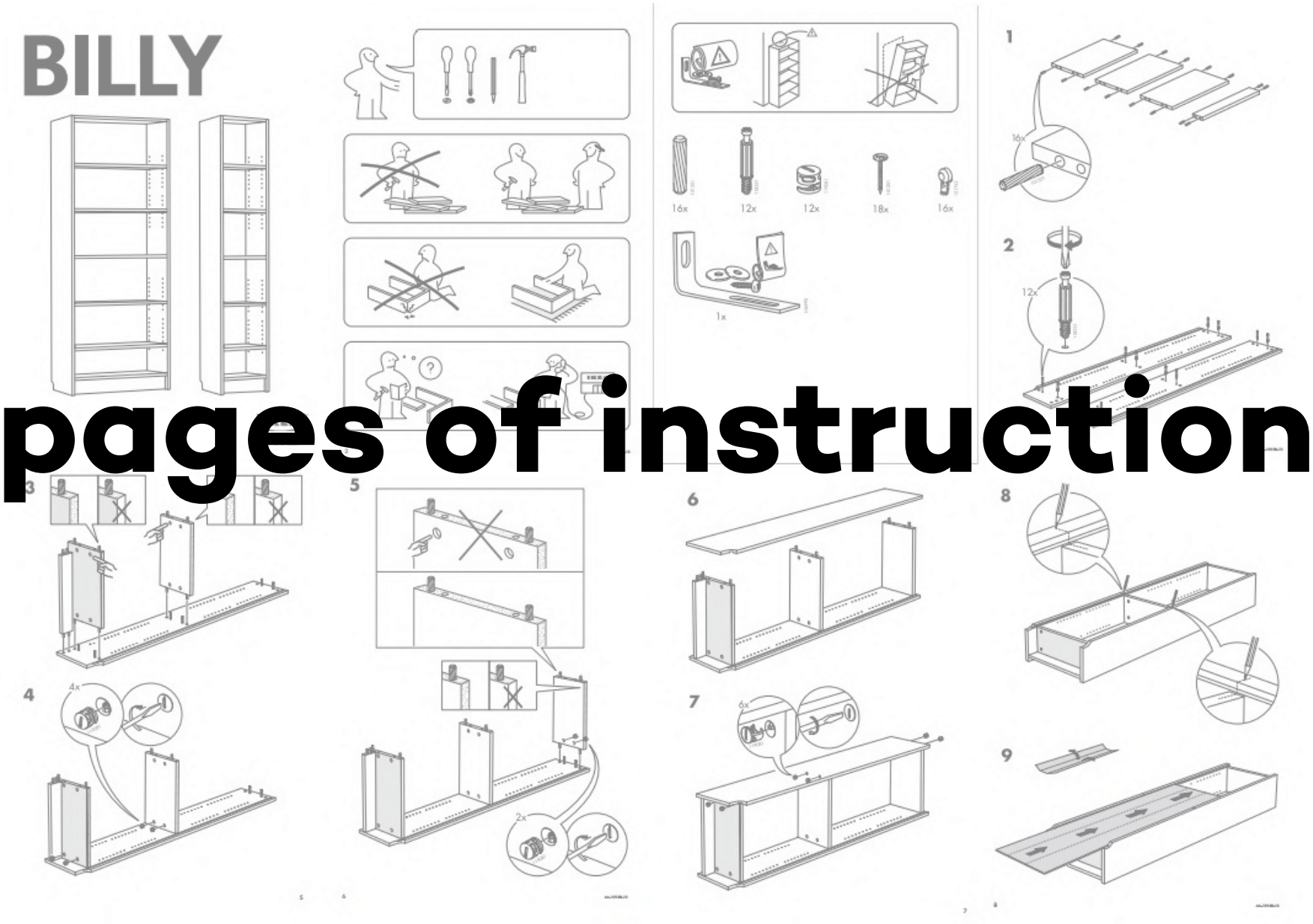
scalable across massive engineering projects.



6 pages of instructions.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10 documents of standards, regulations & requirements, 500 pages each.

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power supply systems of nuclear power
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tromagnetic compatibility (EMC)
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all be reliably protected from the effects
omagnetic interference.

ctrical equipment and related cabling
designed and installed so as to ensure
y themselves do not generate any harm-
romagnetic interference in their operat-
ronment.

5457. The following types of electromagnetic interference, among others, shall be considered in the design of electrical systems, components and cabling:

1. (emission of and immunity to) radiated radio frequency interference;
2. (emission via cables of and immunity to) conducted radio frequency interference; and
3. electrostatic discharge (ESD) tolerance.

5458. Detailed EMC requirements shall be defined in the requirement specifications for safety-classified electrical and I&C systems and components.

5459. One basis for the determination of the EMC requirements is provided by the general international EMC standards for industrial environments. Where necessary, these requirements shall be modified with due regard to the potentially more demanding ambient conditions prevailing at the installation site of individual components.

5460. When the EMC requirements are defined, due consideration shall be given to the exposure of components to potential recurring rapid transients (such as the switching off of inductive loads and the ringing of relays) and high-energy transients (such as various switching transients and strokes of lightning).

5461. When the EMC requirements are defined, due consideration shall be given to electromagnetic interference caused by human action, such as interference emissions from the wireless data transmission and telephone systems and the repair, maintenance and measuring devices used at the nuclear power plant.

5462. A radio frequency table shall be created for the nuclear power plant in support of the preparation of EMC specifications and qualification.

5463. The radio frequency table shall list all the radio frequencies allowed on the nuclear power plant site, including the highest permissible field intensities.

5432. The quality of the alternating current supplied by the on-site emergency power supply system shall be consistently maintained to ensure that the operability of the supplied components is not endangered.

5433. More detailed requirements regarding the equipment used for emergency power supply at nuclear power plants are specified in Guide YVL E.10.

5434. The on-site emergency power supply system shall be provided with a condition monitoring system with a comprehensive set of alarms to promptly alert to and locate failures that prevent or endanger the system's performance.

5435. It shall be possible to safely isolate redundant parts of the on-site emergency power supply system from other electrical systems or system parts for the purpose of functional testing, maintenance and repairs.

5436. In the design of a nuclear power plant, due consideration shall be given to the possibility of a simultaneous loss of the off-site power supply and on-site emergency power supply system (total loss of alternating current supply).

5437. With a view to a total loss of alternating current supply, the plant shall have access to independent alternating current power supply units that are independent of the supply units designed for operational conditions and postulated accidents.

5438. The independent alternating current power supply unit shall fulfil the 72-hour self-sufficiency criterion.

5439. The independent alternating current power supply unit shall be capable of being activated quickly enough while at the same time minimising the risk of human errors.

5440. The capacity of the independent alternating current power supply unit shall be sufficient to maintain the plant unit in a controlled state in the event of anticipated operational occurrences and Class 1 postulated accidents.

5.4.4 Uninterruptible power supply systems

5441. To assure the proper operation of components important to safety requiring uninterruptible power supply, the electrical power supply to such components shall be ensured by means of reliable battery-backed systems that secure an uninterrupted supply of power in the event of a disruption in the supply of alternating current power.

5442. The battery sets, charging devices and any converters shall be dimensioned to assure the operability of uninterruptible power supply systems in accordance with the operating time requirements specified for each individual system.

5443. The battery sets supplying loads important to safety shall be dimensioned to provide a two-hour discharge time under the highest conceivable load.

5444. The battery sets supplying severe accident management systems shall be dimensioned to provide a 24-hour discharge time under the highest conceivable load.

5445. The dimensioning criteria applied for the start-up batteries of combustion engines and other special-purpose batteries shall be justified on a case-by-case basis.

5446. The charging devices of the battery sets related to uninterruptible power supply systems shall be capable of simultaneously supplying electricity to the load consumers and charging the batteries.

5447. The charging devices of the battery sets related to uninterruptible power supply systems shall be dimensioned to deliver full performance even under extreme load conditions (e.g. charging of discharged battery sets and simultaneous supply of loads following a power failure) and operating conditions.

5448. The uninterruptible power supply devices shall be capable of supplying the necessary direct current to the components being supplied even if the battery set is disconnected.

5449. In the event that uninterruptible power supply is provided while the battery sets are disconnected, the electricity being supplied shall be of sufficiently high quality not to cause any disruptions to the components under load.

5450. The uninterruptible power supply devices shall be designed to reliably prevent the transmission of potential disruptions in the supplying alternating current power grid to the final consumers.

5451. Safety-classified uninterruptible power supply systems shall be provided with comprehensive condition monitoring devices complete with alarms to promptly alert to and locate failures that prevent or endanger the system's performance.

5.4.5 Power supply connections between plant units

5452. The power supply systems of nuclear power plant units shall be so designed as to allow the supply of electrical power from one unit to another within the same site to ensure that the latter unit can be maintained in a controlled state in case of loss of electrical power.

5453. The power supply connection between plant units shall be designed to ensure that the probability of the propagation of any electrical failure from one unit to another via such a connection and its unplanned activation and coupling is low.

5454. If necessary, the supply connection between plant units shall be capable of being activated quickly and reliably, while at the same time minimising the risk of human error.

5.4.6 Electromagnetic compatibility (EMC) of electrical and I&C systems

5455. The safety-classified electrical power and I&C systems and components of nuclear power plants, including related cabling and installations, shall be reliably protected from the effects of electromagnetic interference.

5456. Electrical equipment and related cabling shall be designed and installed so as to ensure that they themselves do not generate any harmful electromagnetic interference in their operating environment.

5457. The following
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Engineering is based on written specifications.

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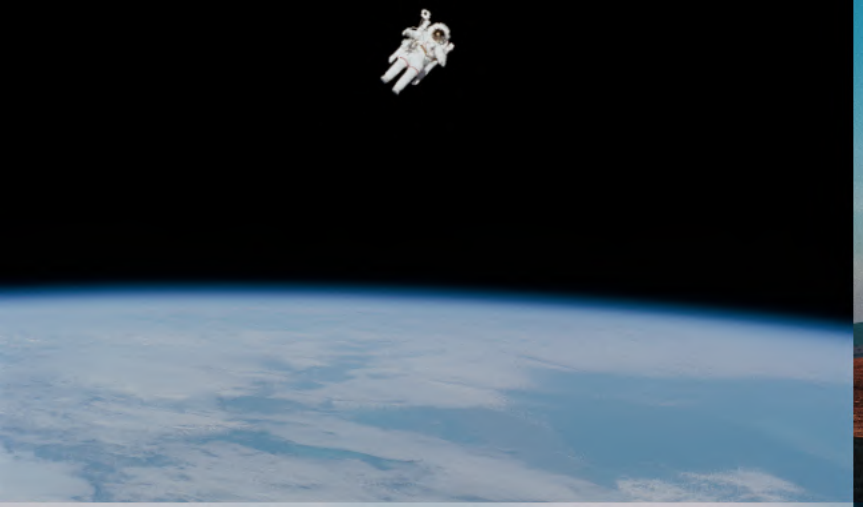
Aerospace



Energy

Oil & Gas

Complex Engineering Systems

Engineering, Construction, Procurement & Management

Marine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87 B€ spent on documentation.

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>50% exceed their budgets.

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SAFETY DESIGN OF A POWER PLANT

3.6 Safety assessment within the design organisation

342. Safety assessments shall be carried out within the design organisation to ensure that the safety requirements are duly fulfilled and the design processes properly executed.

343. The safety assessments shall be carried out by competent experts independent of the design and implementation process. When the assessments involve several fields of technology, cross-technological aspects shall be considered systematically.

344. The safety assessment of the design shall be

1. executed as a continuous process during the design and verification activities; and
2. reported to the licensee in all stages.

345. If several organisations are involved in the design process, the principal supplier of the design work shall carry out an overall safety assessment of the design under the supervision of the licensee.

lished for the plant are met. Deterministic safety analyses shall be made of the initiating events after which the respective safety functions are needed. The functional requirements pertaining to systems performing safety functions shall be specified according to the consequences of such initiating events and the need to mitigate them. Detailed requirements concerning the deterministic safety analyses are given in Guides YVL B.3 and YVL B.5.

350. Probabilistic risk assessments (PRAs) shall be used to assess the probability of severe reactor core damage; the probability of a major release of radioactive substances, the balance of the design; and the risk significance of systems, structures and components. Detailed requirements concerning the probabilistic risk assessment are given in Guide YVL A.7.

351. Failure tolerance analyses shall be carried out to demonstrate that

- all systems performing safety functions and their auxiliary systems satisfy the failure criteria specified in section 4.3 of this Guide;

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346. With systems, structures and components important to safety, it shall be ensured that the safety requirements established for the plant are met. Deterministic safety analyses shall be made of the initiating events after which the respective safety functions are needed. The functional requirements pertaining to systems performing safety functions shall be specified according to the consequences of such initiating events and the need to mitigate them. Detailed requirements concerning the deterministic safety analyses are given in Guides YVL B.3 and YVL B.5.

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- all systems performing safety functions and their auxiliary systems satisfy the failure criteria specified in section 4.3 of this Guide;
- systems assigned to different levels of defence

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Process requirements

Reference requirements

Technical requirements

To do - Sam

- [x] Safety assessments shall be carried out with- in the design organisation to ensure that the safety requirements are duly fulfilled and the design processes properly executed.
- [x] The safety assessments shall be carried out by competent experts independent of the design and implementation process. When the assessments involve several fields of technology, cross-technological aspects shall be considered systematically.
- [x] The safety assessment of the design shall be 1. executed as a continuous process during the design and verification activities; and 2. reported to the licensee in all stages.
- [x] If several organisations are involved in the design process, the principal supplier of the design work shall carry out an overall safety assessment of the design under the supervision of the licensee.
- [x] With systems, structures and components of considerable safety significance, a safety assessment shall be carried out by an independent third-party organisation.
- [x] The design of systems performing safety functions shall be justified by means of deterministic safety analyses. These analyses shall ensure that safety functions can be performed by the designed systems and that the safety targets established for the plant are met. Deterministic safety analyses shall be made of the initiating events after which the respective safety functions are needed. The functional requirements pertaining to systems performing safety functions shall be specified according to the consequences of such initiating events and the need to mitigate them.
- [x] The solutions and methods chosen during the course

To do - Robin

- [x] Probabilistic risk assessments (PRAs) shall be used to assess the probability of severe reactor core damage; the probability of a major release of radioactive substances, the balance of the design; and the risk significance of systems, structures and components.
- [x] Failure tolerance analyses shall be carried out to demonstrate that all systems performing safety functions and their auxiliary systems satisfy the failure criteria specified in section 4.3 of this Guide;
- [x] Failure tolerance analyses shall be carried out to demonstrate that systems assigned to different levels of defence according to the defence in depth approach have been functionally isolated from one another in such a way that a failure in any one level does not affect the other levels;
- [x] Failure tolerance analyses shall be carried out to demonstrate that a common cause failure in any single com- ponent type (e.g. a similar check valve, same type and manufacturer) will not prevent the nuclear power plant from being brought to a controlled state and further to a safe state.
- [x] A failure tolerance analysis shall assess one functional complex at a time, with due regard both to the system that performs a safety function and its auxiliary systems. The analysis shall address each component that, in the event of a failure, may affect the successful execution of the safety function performed by the system following a specific initiating event. The analysis shall address all modes of failure for all the components affecting the system performing the safety function. Depending on the applicable failure criterion, the analysis shall focus on one failure at a time and examine its impact in terms of the operation of the system.

The reactor shall meet the acceptance criteria set for

To do - Alex

- [x] Detailed requirements concerning the deterministic safety analyses are given in Guides YVL B.3 and YVL B. 5.
- [x] Detailed requirements concern- ing the probabilistic risk assessment are given in Guide YVL A.7.
- [x] The requirements for the quality plan that complements the supplier's management system included in the delivery are set out in Guide YVL A.3.
- [x] Probabilistic risk assessments (PRAs) shall be used to assess the probability of severe reactor core damage; the probability of a major release of radioactive substances, the balance of the design; and the risk significance of systems, structures and components. Detailed requirements concerning the probabilistic risk assessment are given in Guide YVL A.7.
- [x] Detailed requirements concerning the events to be taken into account in the design of a nuclear power plant are specified in Guides YVL B.3, B.5, B.7, B.8, A. 11 and A.12.
- [x] The safety divisions hosting redundant parts of safety systems shall be located in different buildings or housed in dedicated compartments to separate them from the other safety divisions in the same building in order to prevent faults from spreading from one redundant system part to another as a result of internal events (e.g. fire, flood or dynamic effects) or external events. Detailed requirements regarding the separation of safety divisions hosting redundant parts of safety systems are provided in Guide YVL B. 7.
- [x] More detailed regulations concerning the physical separation of systems and components within a single safety division are given in Guides YVL B.7 and YVL B.8.

Documentation – a clear cut case for AI.

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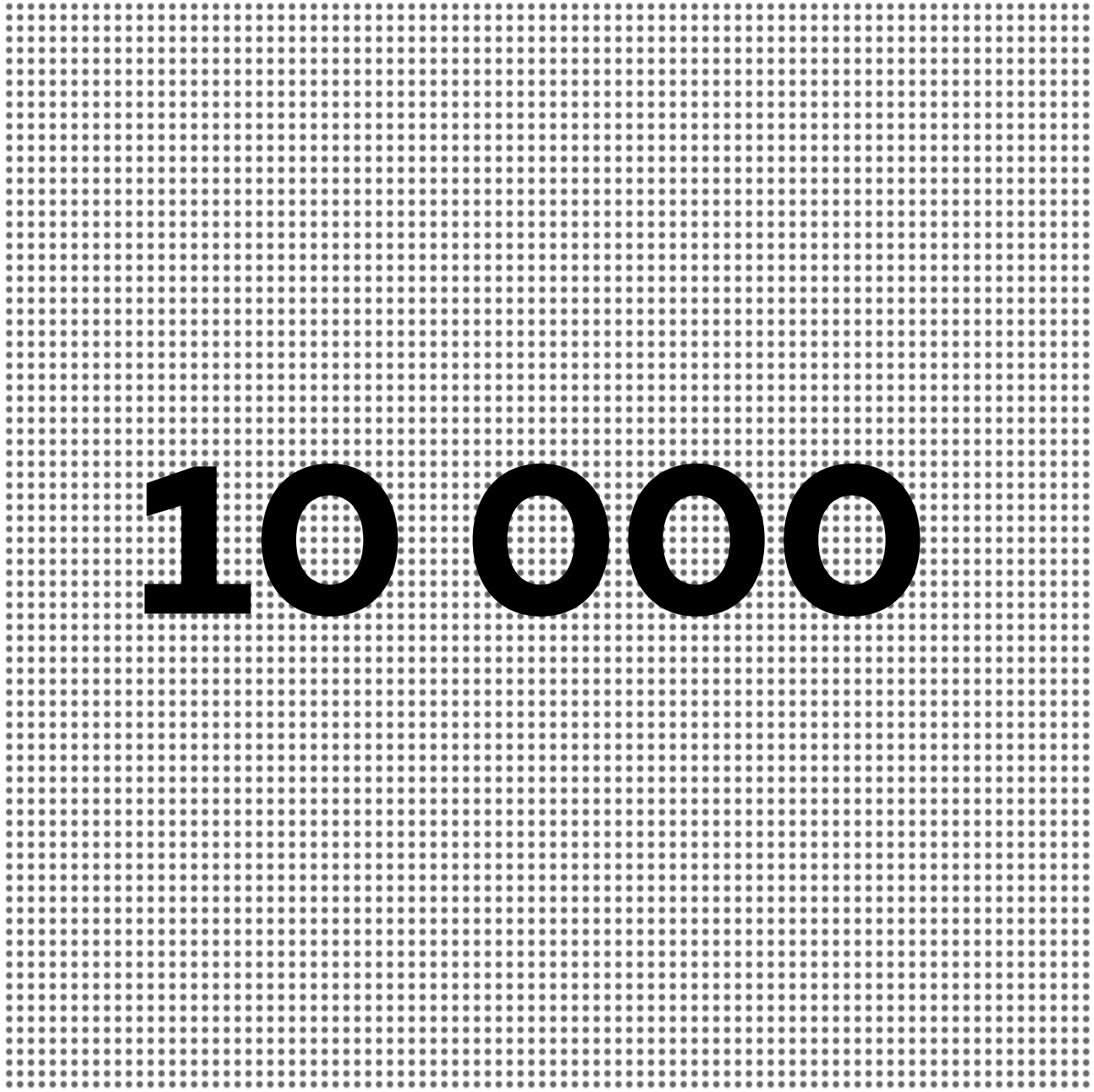
Concentration, time, consistency.

Problem in Deep Learning:

Problem in Deep Learning:

Training AI requires **massive amounts of data,**

which the companies don't have!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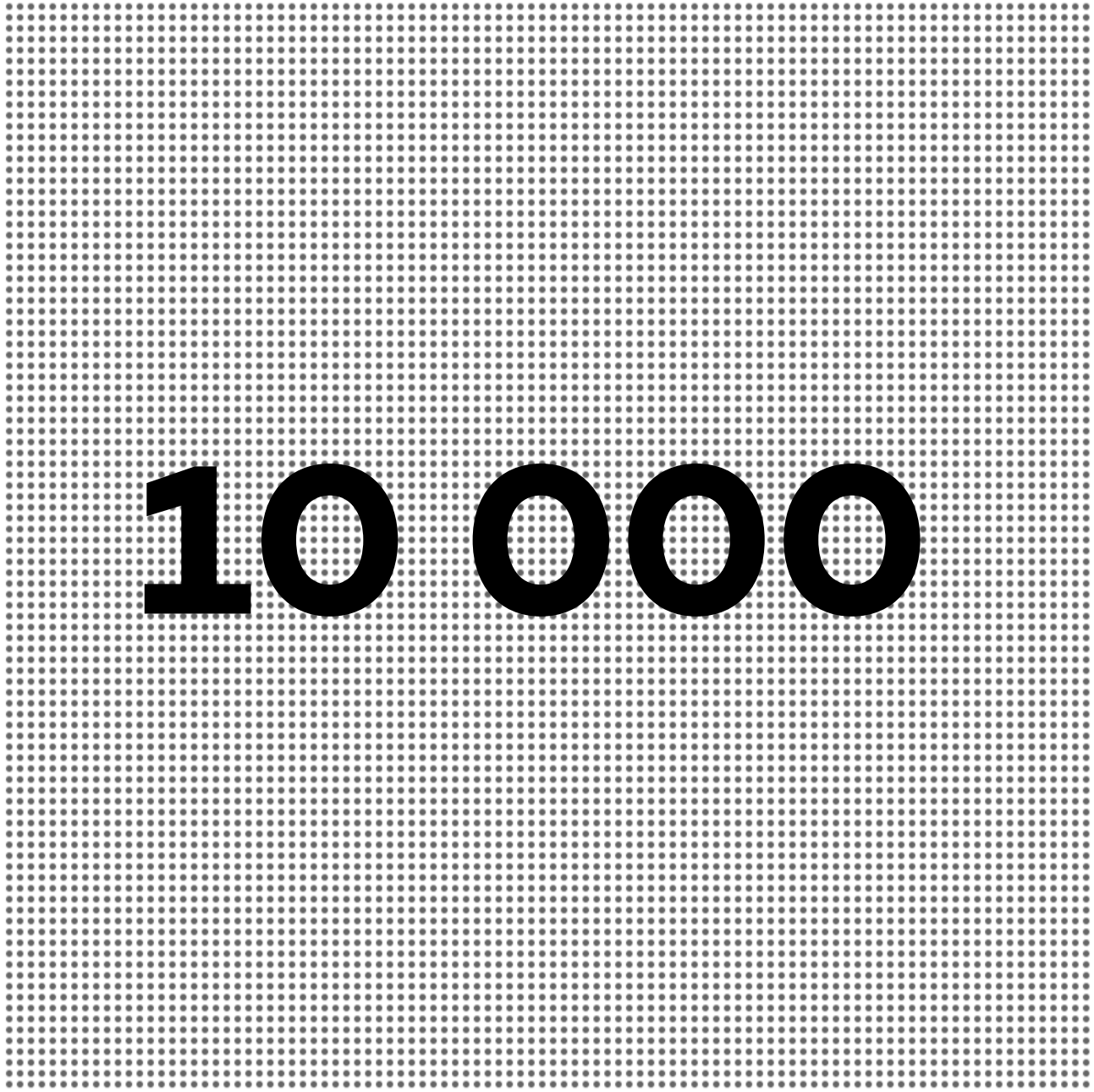

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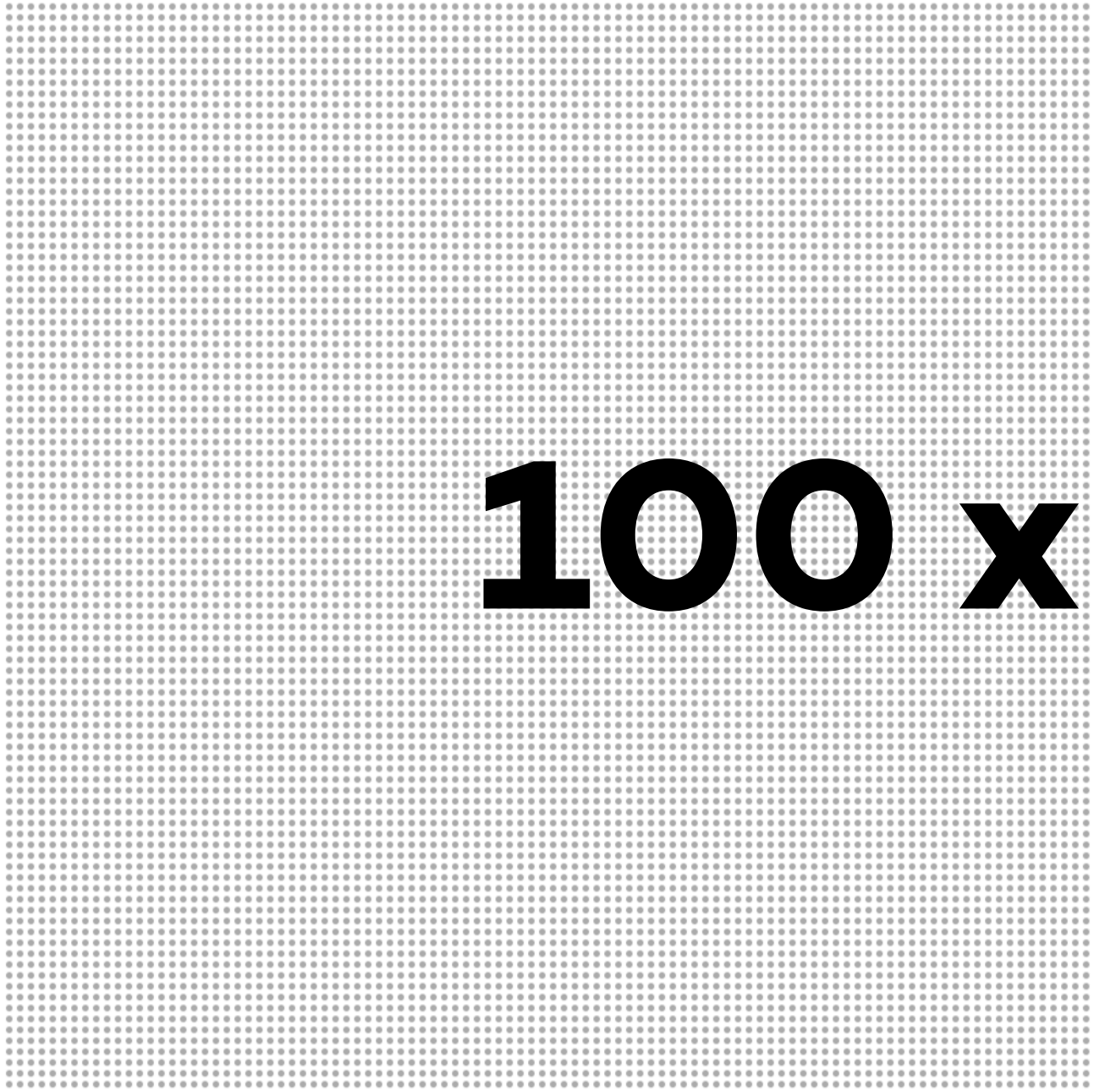

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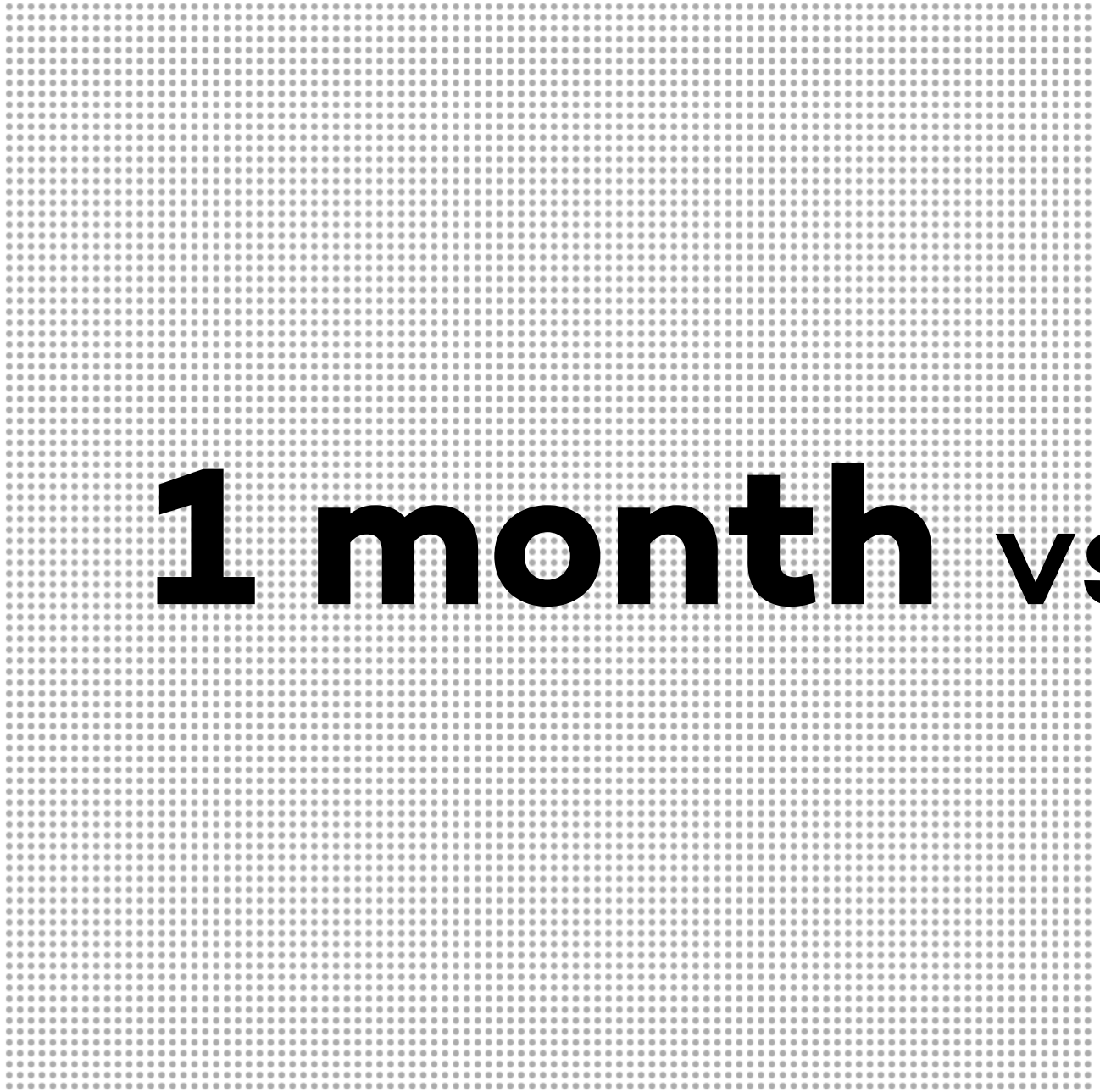

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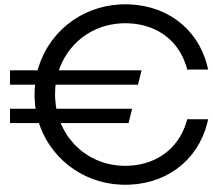
Augmented engineering intelligence.

Augmented engineering intelligence.



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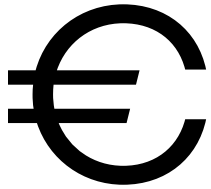
Augmented engineering intelligence.



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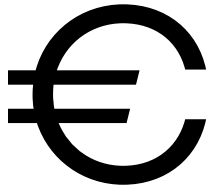

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Faster project delivery.

Improved quality.

Thank you!

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