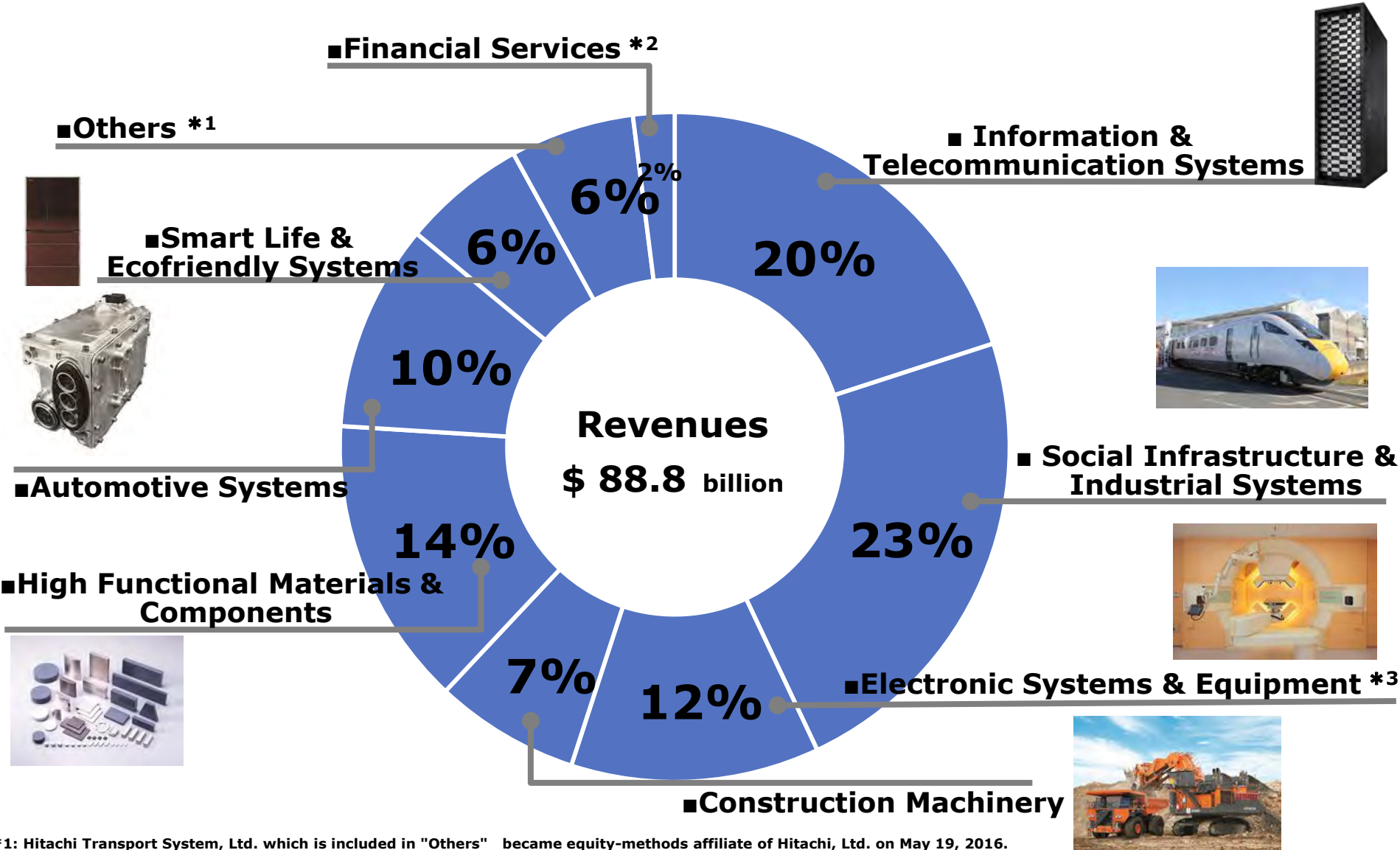


10th International Workshop on the Application of FPGAs in NPPs
Gyeongju, 4-6 December 2017

Introduction of Class 1 FPGA Platform for the UK ABWR

Shohei Nakamura
Satoshi Nishikawa
Takumi Uezono
Toru Motoya

Hitachi, Ltd.



*1: Hitachi Transport System, Ltd. which is included in "Others" became equity-methods affiliate of Hitachi, Ltd. on May 19, 2016.
 *2: Hitachi Capital Corporation which constitute of "Financial Services" became equity-methods affiliate of Hitachi, Ltd. on October 3, 2016.
 *3: Hitachi Koki Co., Ltd. which is included in "Electronic Systems & Equipment " became consolidated subsidiary of HK Holdings Co., Ltd. on May 29, 2017

Global Expansion* (FY2016)

Europe

- Revenues: **\$ 8.4** billion
- Number of companies: **133**
- Number of employees: **14** thousand

North America

- Revenues: **\$ 11.3** billion
- Number of companies: **97**
- Number of employees: **20** thousand

China

- Revenues: **\$ 8.2** billion
- Number of companies: **140**
- Number of employees: **44** thousand

Japan

- Revenues: **\$ 46.3** billion
- Number of companies: **208**
- Number of employees: **169** thousand

Asia (incl. China)

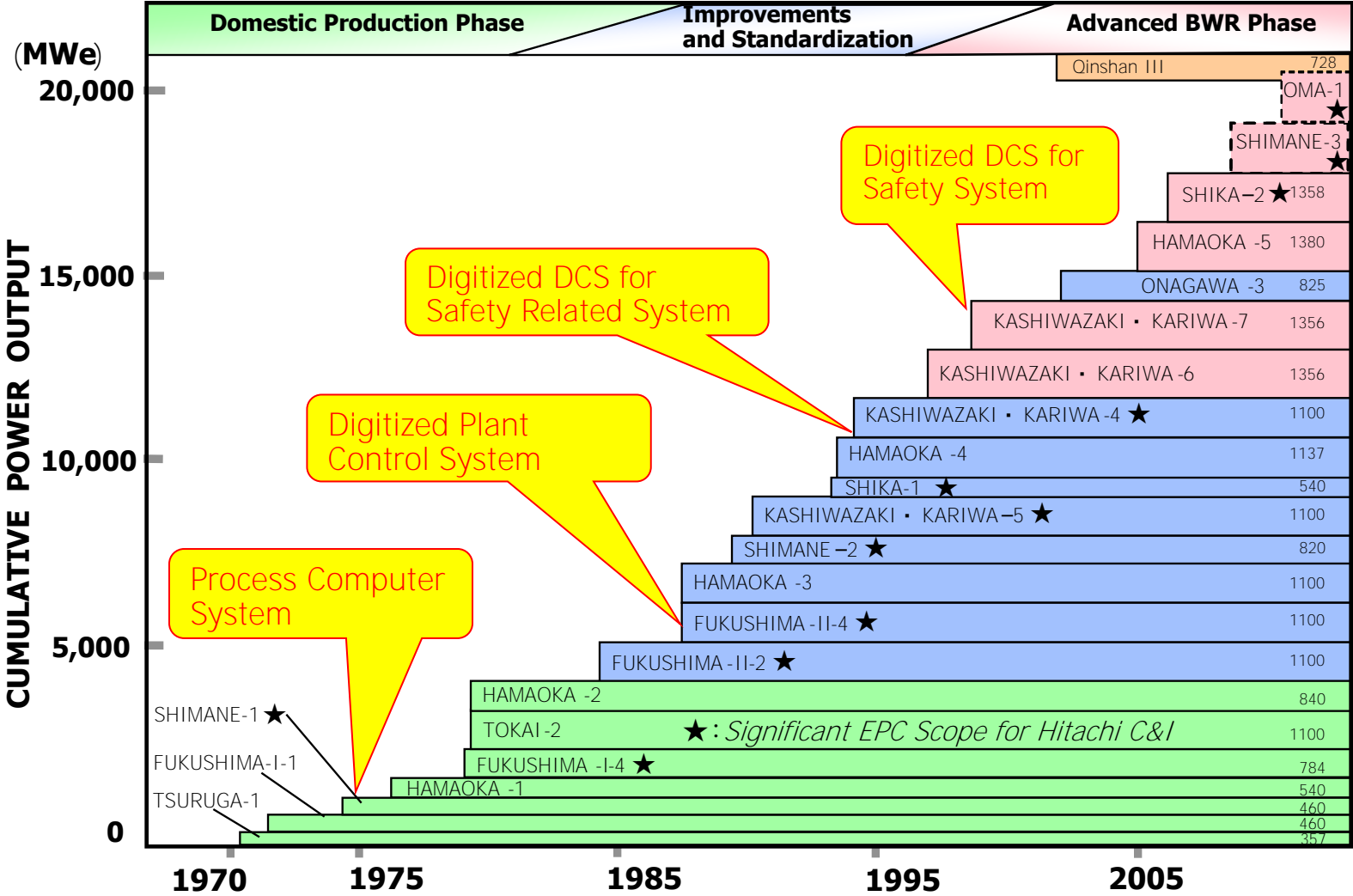
- Revenues: **\$ 18.7** billion
- Number of companies: **325**
- Number of employees: **86** thousand

Other Areas

- Revenues: **\$ 4.1** billion
- Number of companies: **101**
- Number of employees: **12** thousand

Japan	Revenues: \$46.3 billion/Number of companies: 208 /Number of employees: 169 thousand
Outside Japan	Revenues: \$42.5 billion/Number of companies: 656 /Number of employees: 134 thousand
Total	Revenues: \$88.8 billion/Number of companies: 864 /Number of employees: 303 thousand

Hitachi Nuclear Application History



DCS: Distributed Control System

Note: Definition of Safety System and Safety Related System is based on IAEA Safety Glossary 2007

Ohma Unit 1 (NI and TI), FAT finished (FSS), completed in 2016

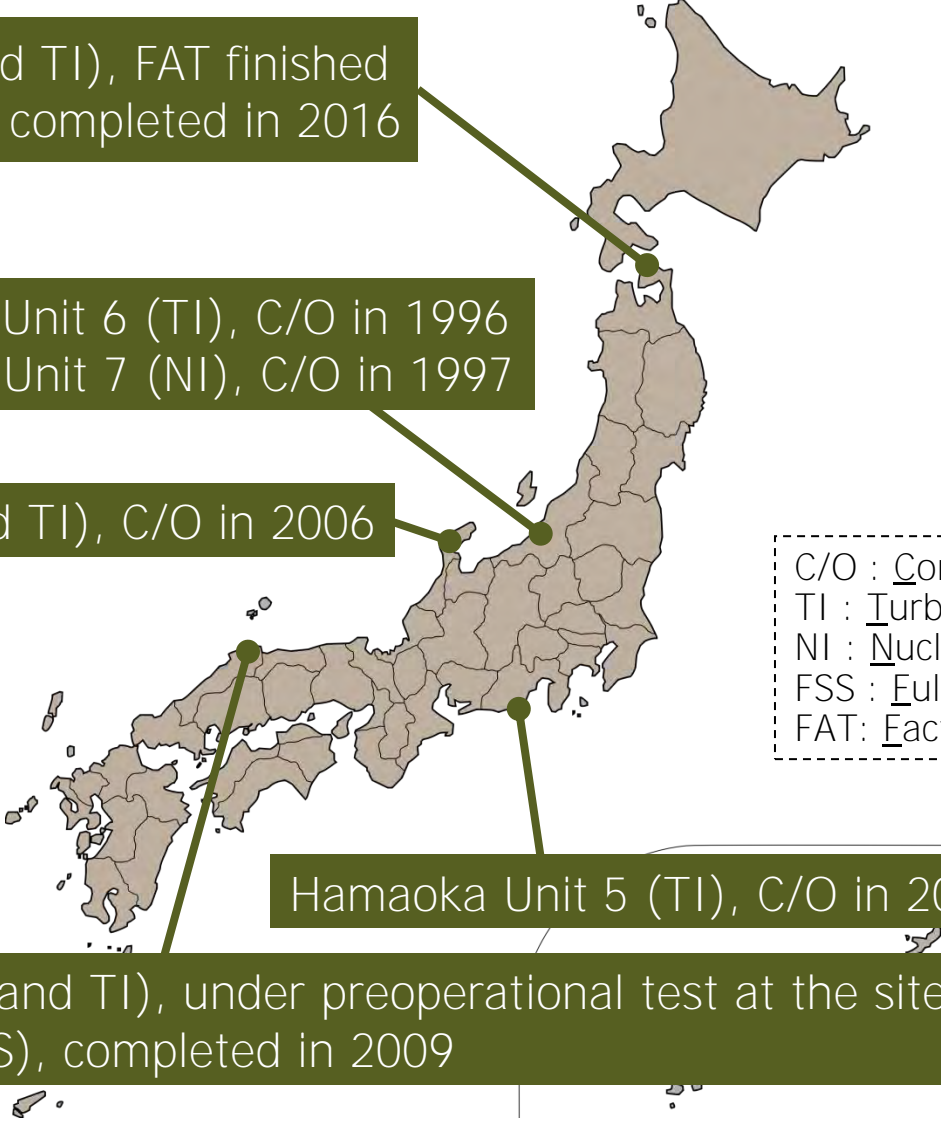
Kashiwazaki-Kariwa Unit 6 (TI), C/O in 1996
Unit 7 (NI), C/O in 1997

Shika Unit 2 (NI and TI), C/O in 2006

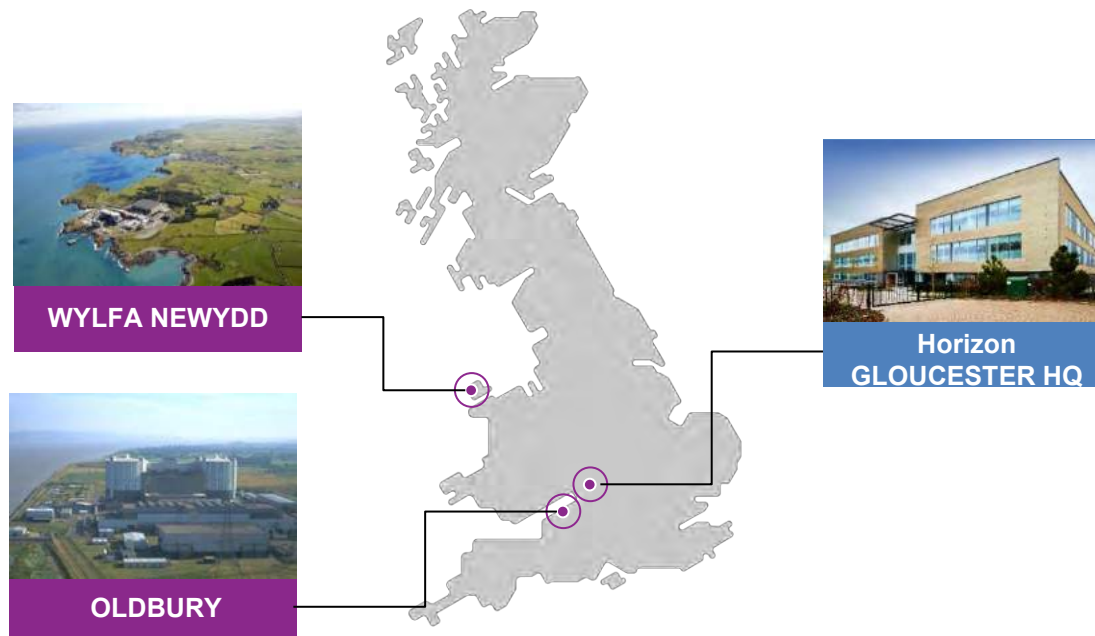
C/O : Commercial Operation
TI : Turbine Island
NI : Nuclear Island
FSS : Full Scope Simulator
FAT: Factory Acceptance Test

Hamaoka Unit 5 (TI), C/O in 2005

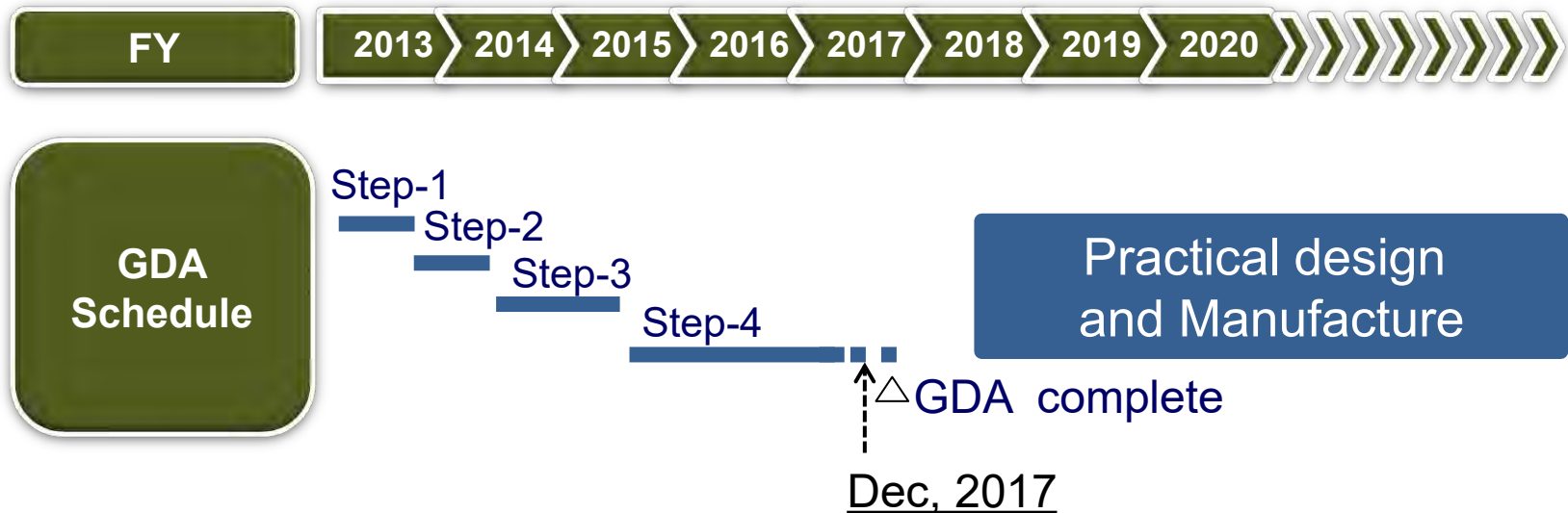
Shimane Unit 3 (NI and TI), under preoperational test at the site (FSS), completed in 2009



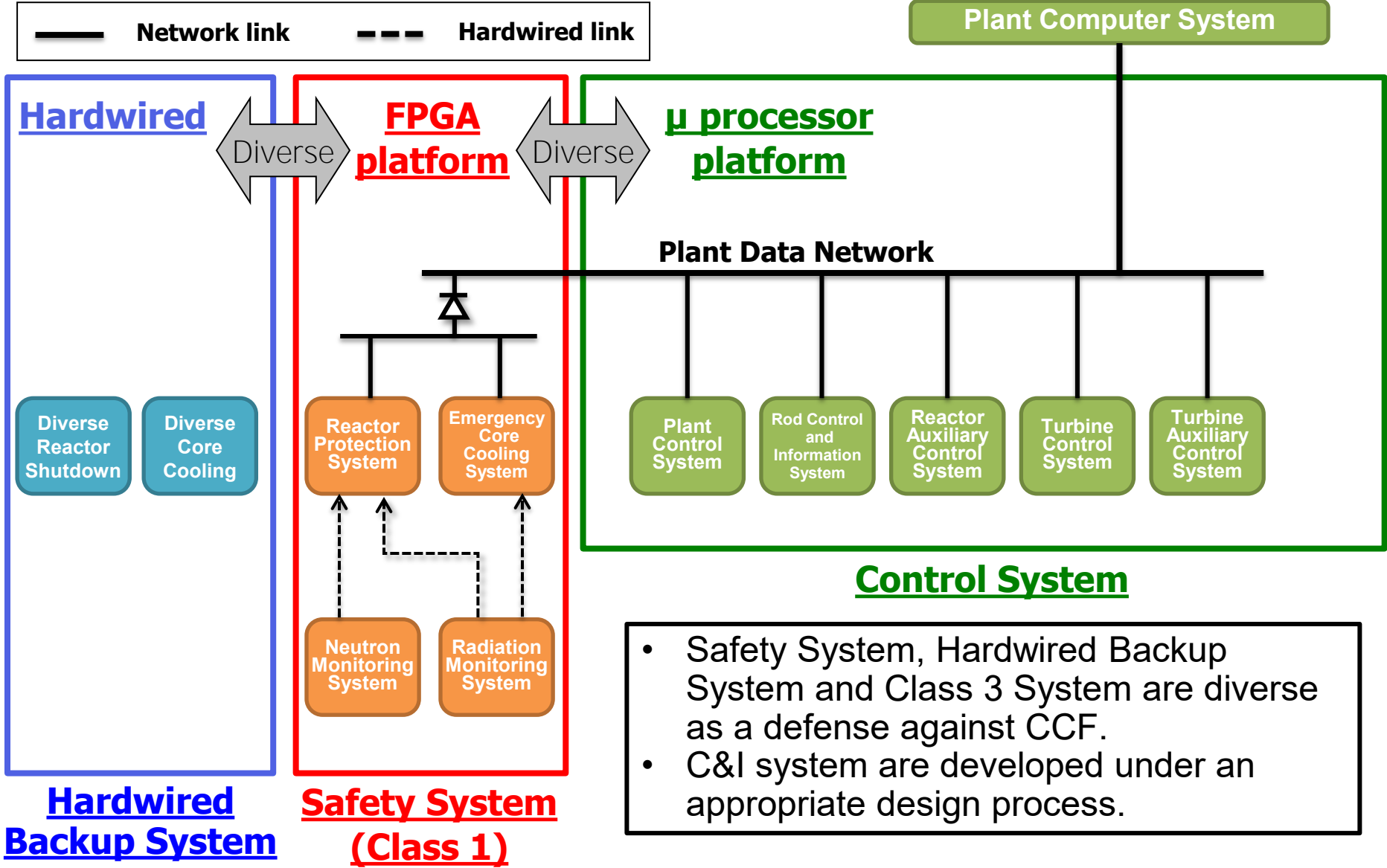
- Horizon Nuclear Power is planning to build 1,350 MWe class Advanced Boiling Water Reactors (ABWR) in Wylfa and Oldbury.
- The primary focus is to secure all key agreements and permissions in place for the Final Investment Decision in 2019.
- Commercial operation of the 1st unit at Wylfa is planned to be in the first half of the 2020s.



- Hitachi-GE Nuclear Energy as an ABWR supplier, officially applied Generic Design Assessment (GDA) licensing process to the UK regulator in 2013.
- Final process of Step-4 will be completed during the month of December, 2017 **on schedule!!**



Overall UK ABWR System Configuration



- Safety System, Hardwired Backup System and Class 3 System are diverse as a defense against CCF.
- C&I system are developed under an appropriate design process.

- Development process Complies with IEC61513, 62566
- Each module has FPGAs inside, and communicates through the safety field bus on the back-plane.

- Logic Unit

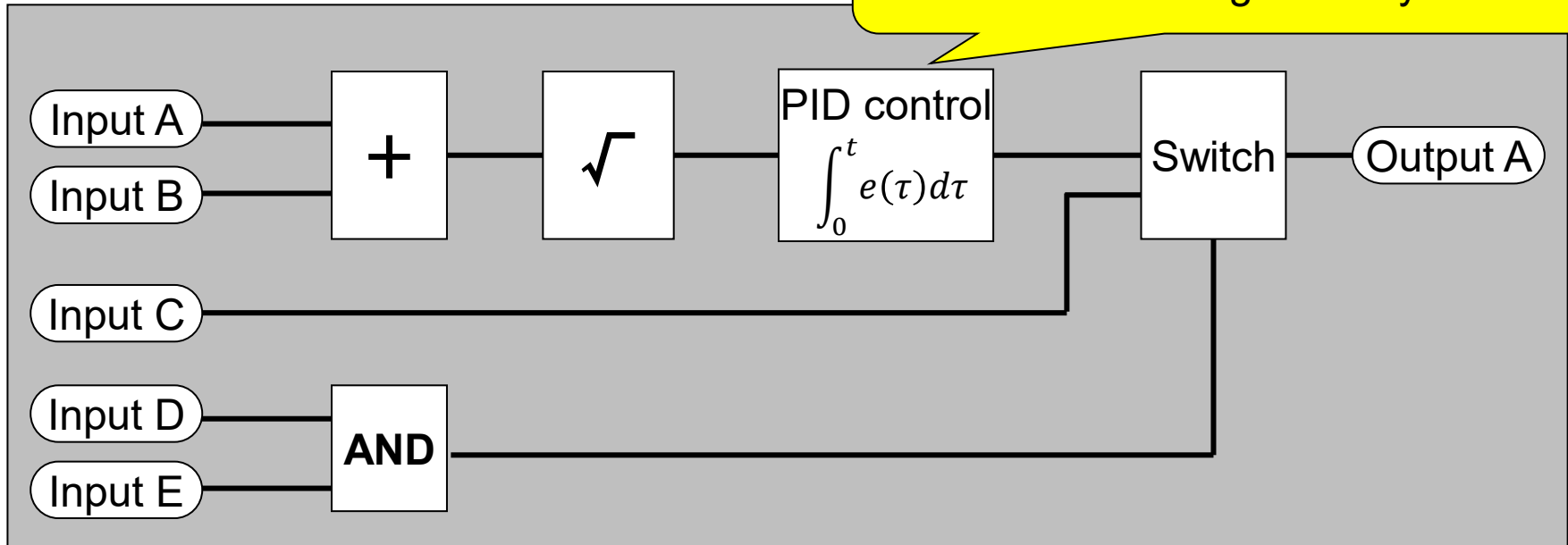
- without Processor, Firmware, OS, Middleware
- supporting floating-point arithmetic without FPGA
vendor's floating-point IP cores



DI, DO, AI, AO, Interface module

- Can be designed as function block diagram using general design tool
- Support wide variety macros which are developed as white-box
 - Essential analog macro ; about 10 types (+, −, ×, ÷, √...)
 - Simple digital macro ; about 30 types(AND, OR, Flip Flop, ...)
 - Advanced function macro ; about 30 types(PID control, Switch, ...)
 - The others are under development.

User can use **10,000+** macros in a LU and can design flexibly !!



Functional Safety

Defend against inside failure

IEC 61508 SIL3 (Single) /
SIL4 (Redundant Configuration)

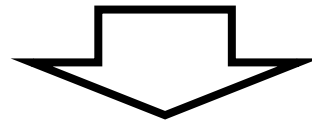
Cyber Security

Defend against outside attack

IEC 62443-4 SL1

Qualified in Jun 2017 from certification body!!!

(Plan to be certified in early 2018)



Our platform combines
Functional safety and Cyber security

Further information and our know-how to be shared after GDA passing!
(GDA, Safety & Security, FPGA control, etc...)

END



Introduction of Class 1 FPGA Platform for the UK ABWR

Shohei Nakamura
Satoshi Nishikawa
Takumi Uezono
Toru Motoya

Hitachi, Ltd.

HITACHI
Inspire the Next 