HSE

Occupational Health & Safety
and Environmental Protection unit

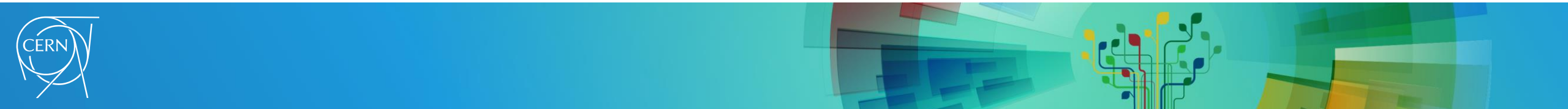
CARE Project

CSTSC on Cables and Connectors

6th April 2022

J. Gascon

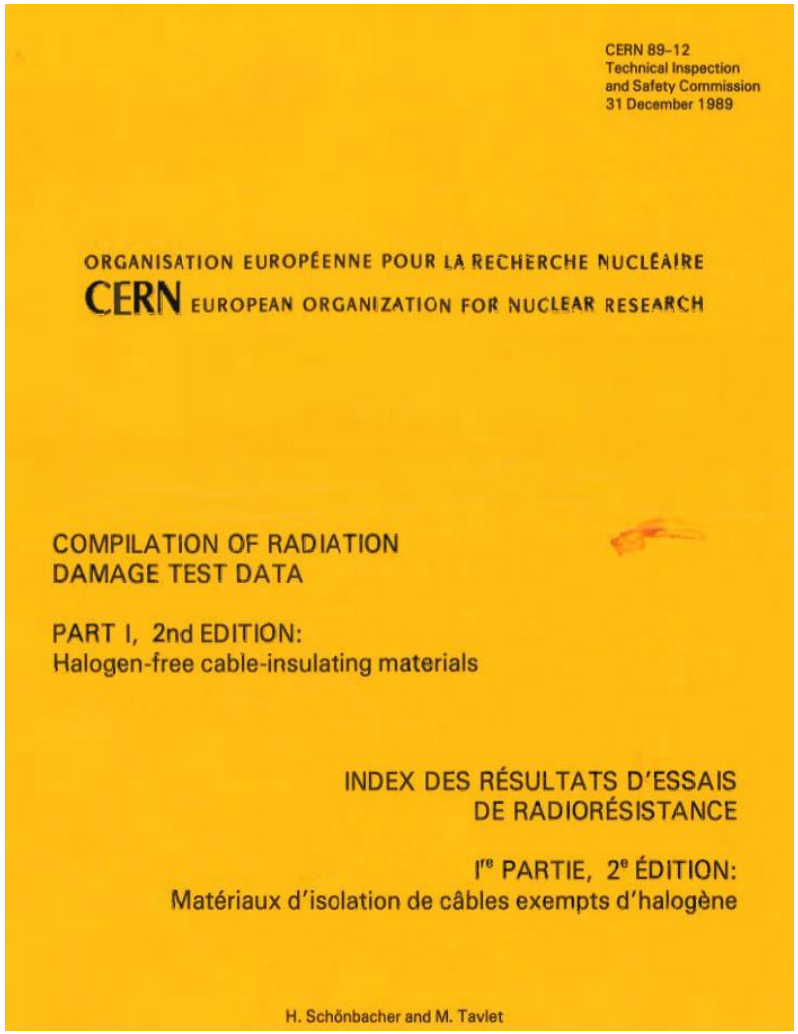
on behalf of CARE project team



CARE motivations

CERN's motivations for the CARE project

- **Cable procurement cost**: cable price, quality control & storage requirements *(now based on IS23)*
- **Replacement cost**: manpower for removing and pulling
- **Personnel safety cost**: more workers in radiation areas *(Limited Stay and High Radiation Areas)*
- **Time schedule**: time required during LS & TS *(radiation cooling limits time for works)*
- **Waste cost**: irradiated cables are radioactive waste and require treatment expenses



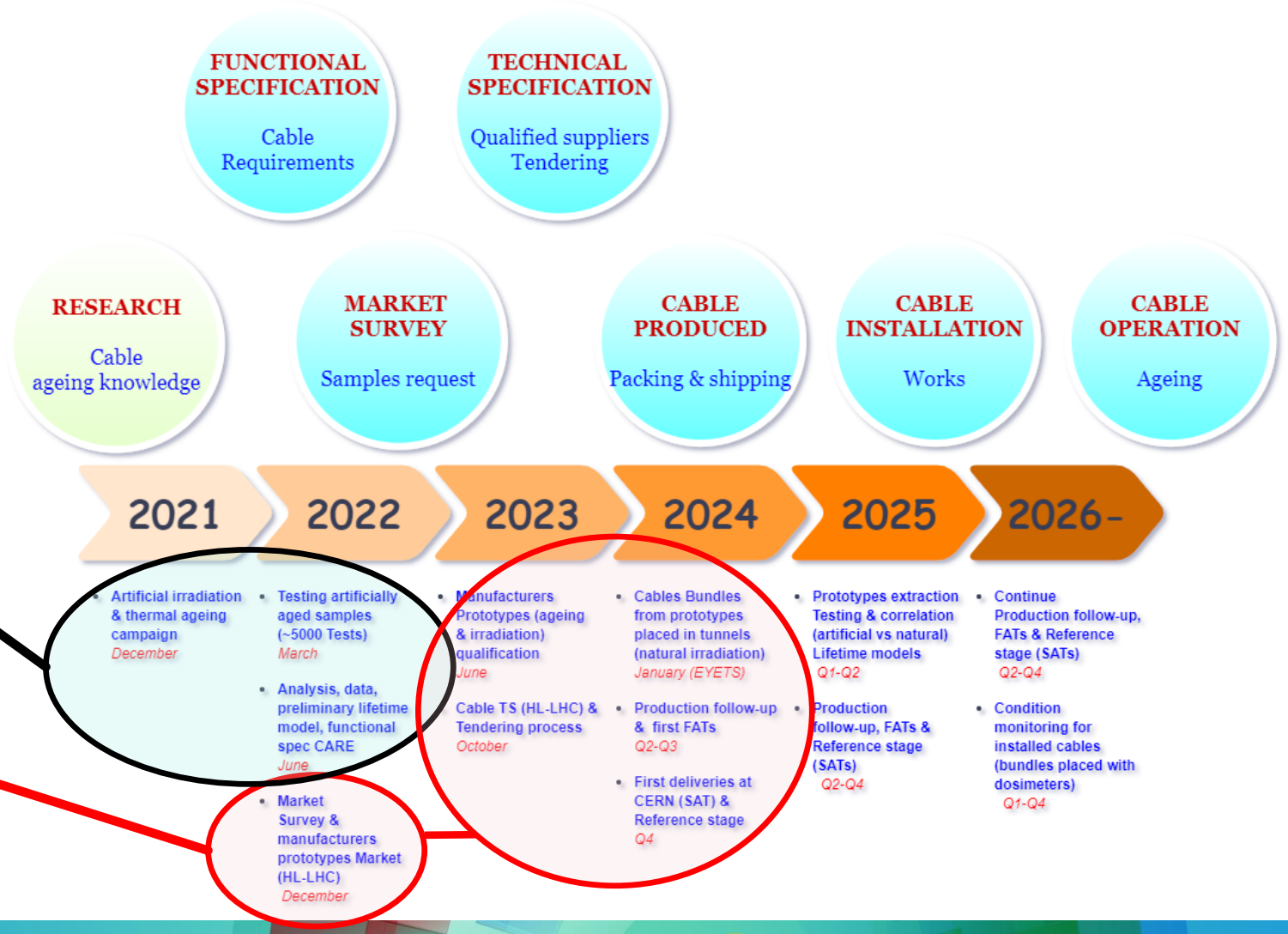
CARE Project Objectives

- ✓ **Focus on new purchasing cables contributing to**
  - establish technical requirements & acceptance criteria in terms of radiation & ageing
  - improve quality control
  - provide condition monitoring along the life cycle of sensitive cables
- ✓ **Enhanced decision-making process developing lifetime models on ageing cables**
- ✓ **Develop database & logbook for “sensitive” new installed cables**
- ✓ **Expertise on cable ageing mechanism & testing techniques**

CARE proposal to HL-LHC

March 2022

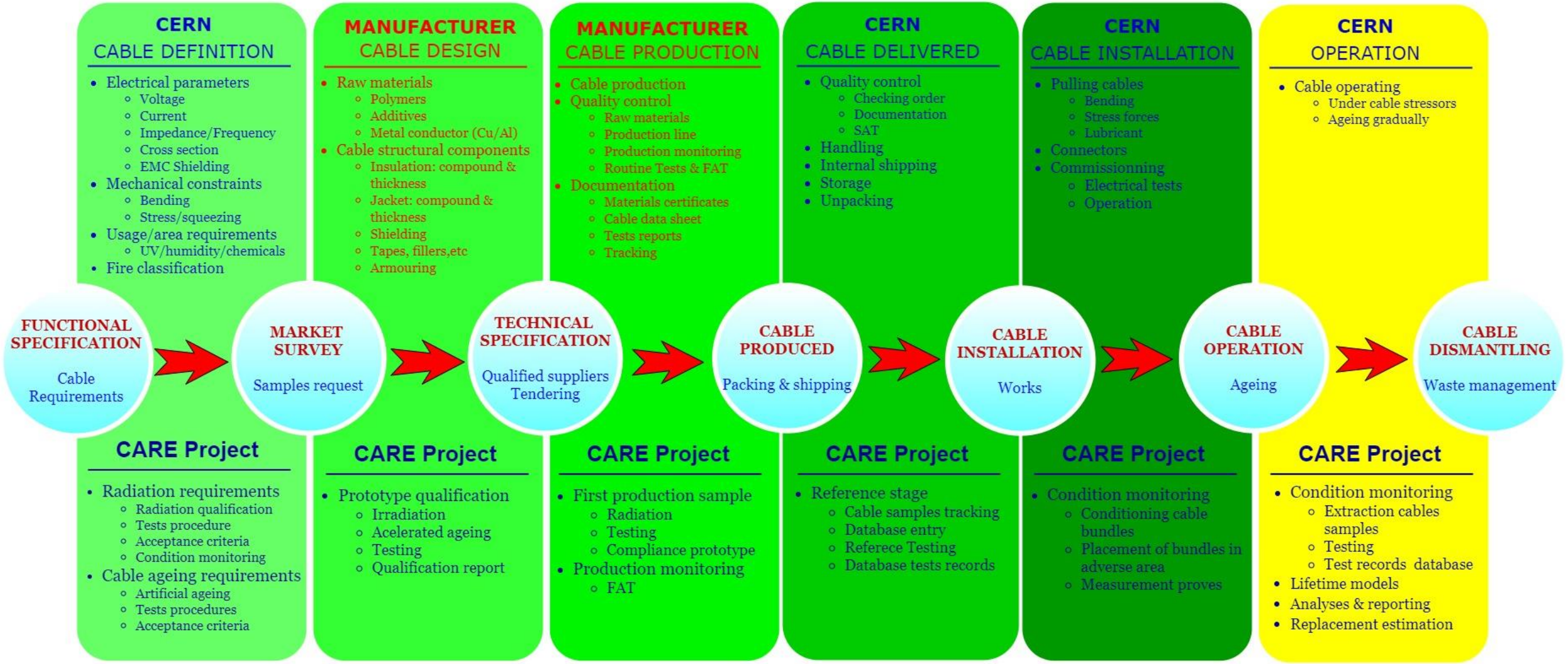
CARE Scheduled on going 2 months delayed by Irradiation facilities



- **Samples expected for qualification from manufacturers by mid 2022**
- **Requirement and acceptance criteria definition by September 2022 (IT)**
- **First cable batch delivery expected in 2024**

CARE Project milestones

CABLE LIFE CYCLE



QUESTIONS?

Additional slides

WP1 Management

✓ Cable technology

- **Cable composition:** raw materials, compounds, jacketing, additives, structure
- **Manufacturing:** cable production processes like polymers extrusion, additives bl, cross-linking, etc.
- **Influence of stressors on cable:** polymers reactions, additive reactions, lifetime prediction

✓ Testing research

- **Ageing test techniques:** determine appropriated tests technique by stressor and type of polymer
- **Test techniques research:** define tests parameters, measurements and equipment required
- **Cable samples:** determine samples conditioning for testing

✓ Management

- **Reporting:** preparation of reports and conclusions from results
- **Documentation:** preparation and management of procedures within the project
- **Plan:** deploy the strategy to be followed by the different WPs

WP2 Cable procurement

✓ Cable design

- **Technical requirements:** provide cable parameters required for the cable stressors presents in the facility
- **Polymer selection:** propose the most appropriated polymer according to cable stressors
- **Test techniques:** provide type and routine tests to be performed by cable manufacturer
- **Documentation:** technical documentation to be delivered with the cable supply (data sheet, test records, cable composition, additives, etc.)

✓ Acceptance criteria

- **Prototypes:** provide technical support to select the most convenient cable among manufacturers proposals
- **FAT:** routine tests criteria for acceptance
- **SAT:** criteria for CERN site acceptance

✓ Manufacturing process

- **Audit:** technical support on manufacturing quality control
- **Witnessing:** participation on FAT and SAT

WP3 Data management PLM

✓ Database

- **Cable codification:** cable codification per batch (drum codification) where attach all cable data information
- **Cable data sheet:** cable parameters (electrical & mechanical) and drums length
- **Tests records:** prototype tests records, FAT, SAT, samples tests performed in WP5 (source files)
- **Samples codification:** codification of cable samples to be used in WP4
- **Specification stressors:** technical requirements asked in WP2 and location stressors

✓ Mathematical statistics

- **Correlation:** statistic models to compare testing results among test techniques
- **Models:** research on mathematical models to predict lifetime of cable

WP4 Condition Monitoring

✓ Sensitive areas

- **Identification:** identify the most appropriated areas to place samples by stressors expected values
- **Placement:** accurate spot in the zone for the samples
- **Geometry:** position and conditioning of samples
- **Equipment:** define the most appropriated sensors to measure real stressor values

✓ Samples management

- **Installation:** put in place samples in the identified areas
- **Stressor follow-up:** follow-up sensors and measurements obtained from sample area
- **Extraction:** collect samples on demand
- **Data:** provide all measurements data obtained to be treated by WP3

WP5 Cable testing

✓ Samples conditioning

- **Preparation:** sample handling for tests as defined in WP1 procedures
- **Measurements:** provide data to WP3 on measurements of specimens prepared (shape, weight, etc.)
- **Feedback:** provide continuous feedback to WP1 on sample preparation difficulties

✓ Testing

- **Tests:** perform all tests techniques in prepared specimens according the WP1 procedures
- **Measurements:** provide source data obtained in tests to WP3
- **Feedback:** provide continuous feedback to WP1 on tests difficulties