A Roadmap for Installing and Commissioning New Equipment

-

Introduction

Sonja Dieterich, Ph.D.
Associate Professor, UC Davis

You are responsible for commissioning a new linac.
You have not done this before.
It is now a few months before project start.
EVERYONE wants to know:

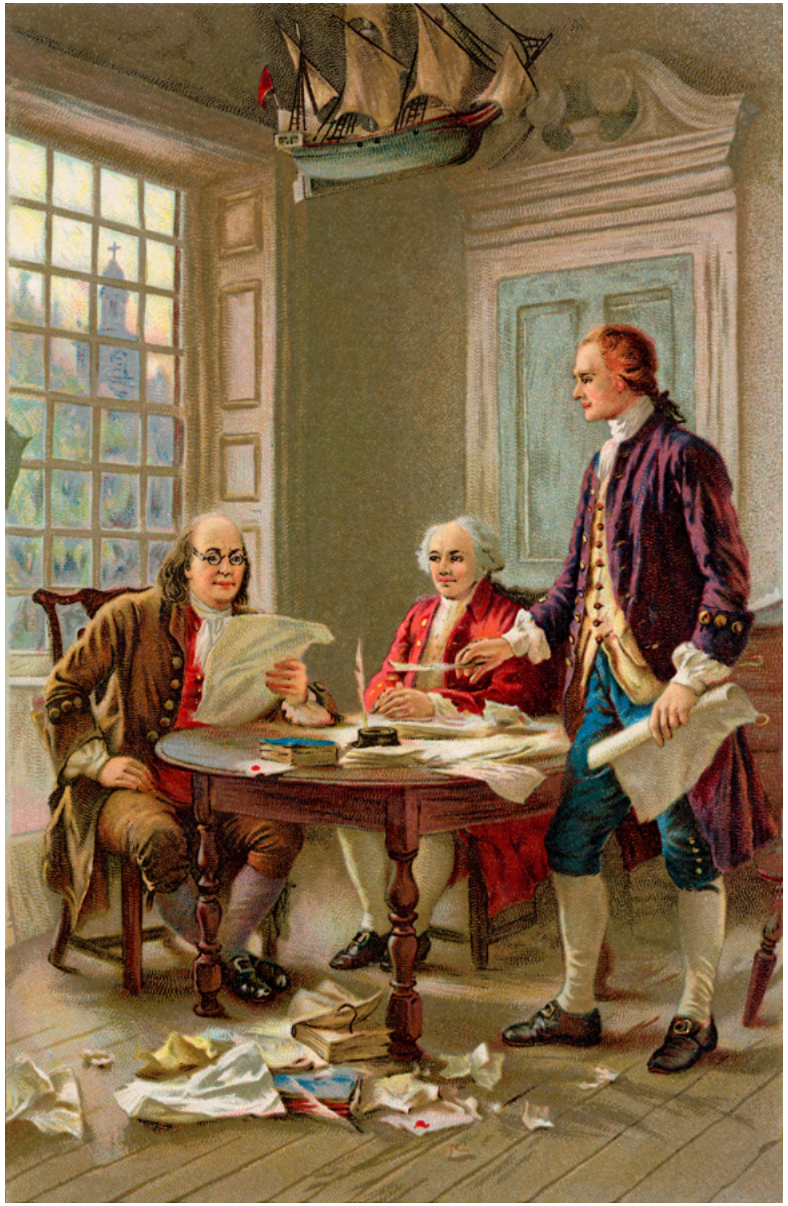
When are we treating the first patient?

Learning Objectives

1. To learn how to build a new equipment commissioning project plan
2. To identify equipment , personnel resources and commissioning time required
3. Understand how to account for commissioning new technology with small install base
4. Learn to develop a representative commissioning plan for a linac, CK, HDR unit or treatment planning system

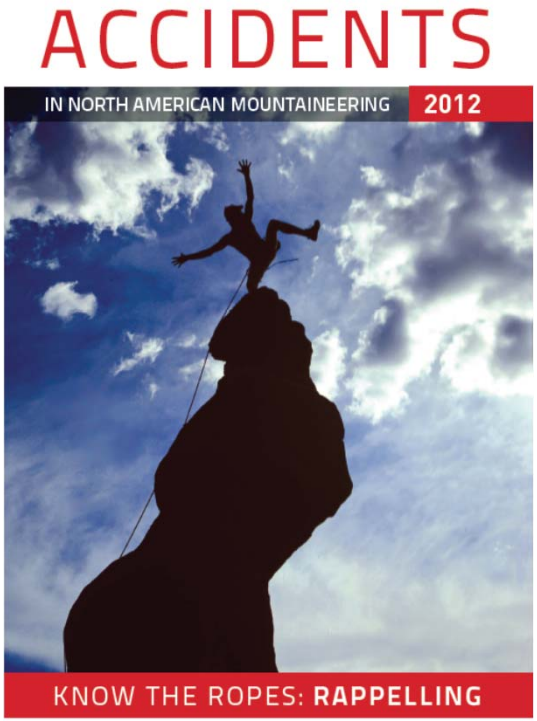
The handout of this lecture is available as pdf on meeting website

"An ounce of preparation is worth a pound of cure" (Benjamin Franklin)



In so much more words …

- Good preparation saves you time. Lots of it.
- Good preparation helps you understand precisely what you need to do.
- Good preparation lowers the risk of serious errors
- Good preparation allows you to recover quickly from the unexpected



1/3 of accidents have contributing causes originating from **inadequate preparation**

Typical Schedule of Events

1. Construction and Install
   - Removal of existing equipment (riggers)
   - Room Infrastructure (hospital/vendor contractor)
   - Install of new equipment (riggers, vendor)
   - Cosmetic fixes (hospital contractor)

2. Acceptance testing
   - Physicist with vendor personnel
   - Tests defined in vendor acceptance testing document

3. Commissioning
   - Radiation Safety Measurements
   - Beam Data
   - TG-119, Imaging QA, E2E tests, TPS for new machine …
   - Policies and procedures

4. Clinical Go-Live
   - Training
   - First patients

Construction: Building and Room

- Mostly handled by facilities/vendor **except**:
- Planning phase:
  - Shielding calculation, peer review of shielding calculation
  - Room design: storage, cable ducts, monitors & camera positions …
- Actual construction:
  - **Go visit the site regularly!!!**
    - Base frame on wrong site of couch!
    - empty soda can thrown into primary barriers …
  - Take photos for future reference: e.g. cable duct location

Construction: Install of Equipment

- Performed by vendor
- Learn about components from engineers
- Touch base daily to find out about possible delays

Acceptance Testing

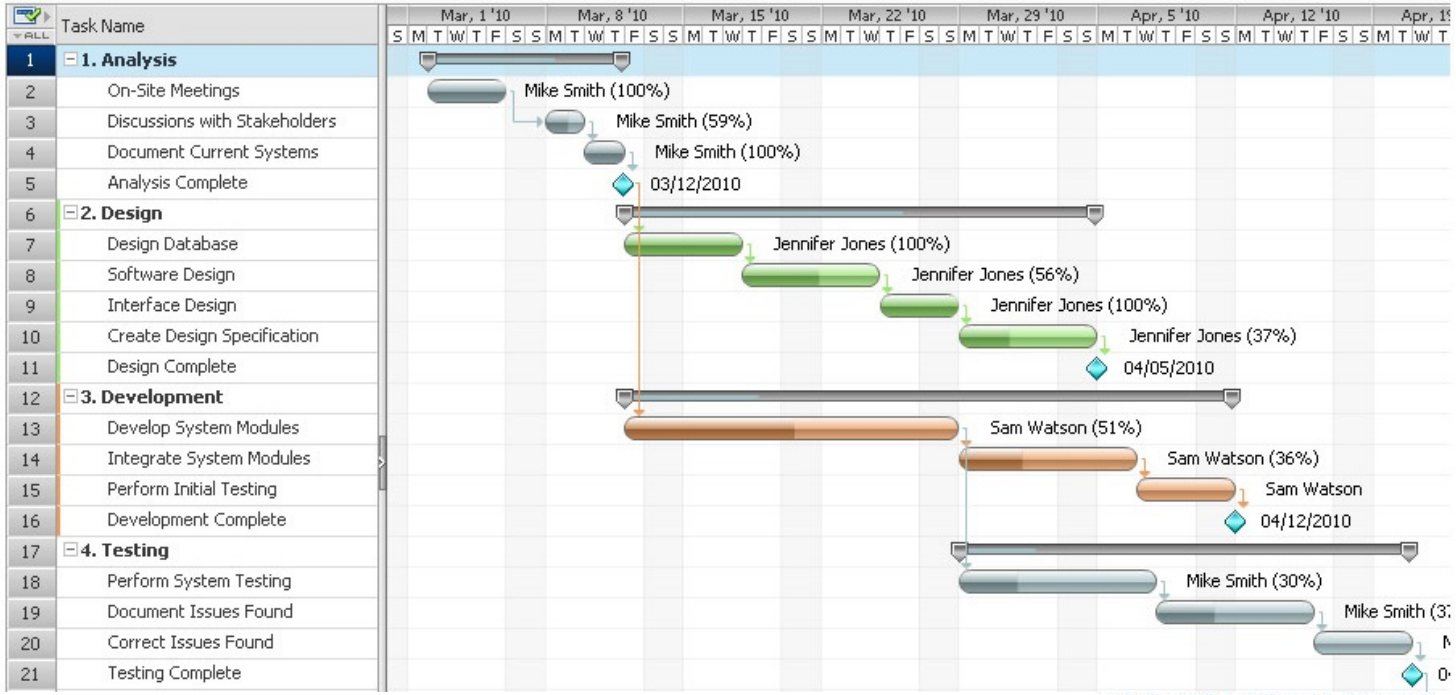
- Definition: Vendor demonstrates to you that the machine fulfills all specs *as defined in the purchase contract*
  - **Get a copy of the purchase contract and acceptance testing document well in advance**
- Time for acceptance testing is often **NOT** included in install time estimates!
- Your signature on acceptance testing document transfers the machine from vendor owned to hospital
- Any changes made after this will be covered by service contract (if applicable) or **charged**
- Therefore: do not accept tests results that are just barely meeting specs (e.g. 0.95 mm for a 1 mm tolerance)
  - Diplomatically but firmly push the engineer
  - remember 80/20 rule.

Where do I find information on what I need to do for commissioning?

- AAPM TGs:
  - Tests and tolerances
  - Equipment
  - No information on time or personnel ☹ except TG 179 ☺
- Publications:
  - Detectors, methods
  - Reference beam data (e.g. small field output factors)
  - TPS manuals (e.g. Pinnacle has a nice guide specifying beam data needed for modeling)
- Peers:
  - Copy of commissioning reports
  - Time estimates
  - Lots of useful tips & tricks

Commissioning

- Details covered by following speakers
- Consider developing a Project Chart
  - Helps the visual thinkers
  - Great communication tool (admins, physicians)



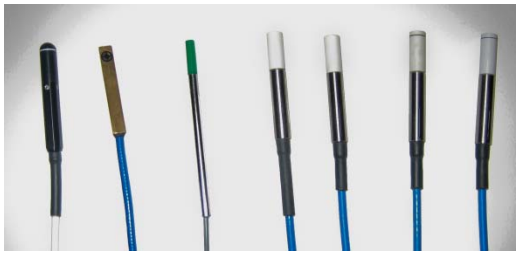
Commissioning: People and Coverage

- Staff
  - How many people available for commissioning?
    - Make sure not taking vacation gets discussed …
  - Possibly working early/late shifts?
  - Who covers the rest of the clinic?
- Other departments:
  - IT: connectivity, firewalls, backup
  - RSO: Shielding Survey

Commissioning: Equipment

- List of equipment and materials:
  - Water Tank
  - Detectors: chambers, film , gels
  - Daily, monthly and DQA phantoms
  - Outside calibration check (RPC, peer review)
  - BEAM DATA (golden sets, peers, publications)

- Check functionality:
  - Water tank: maintenance, software update
  - Chamber calibration up to date?
  - Film expiration date, enough supplies
  - Test equipment in existing beam



Commissioning: Preparing A Road Map for Tasks

- Create a road map document:
  - **List** of measurement tasks (use outline function). Under each list entry, write down:
    - Estimated time needed***
    - Equipment needed
    - 1-2 sentences on setup
    - Data processing method (if applicable)
    - List tolerances if applicable
    - Result: Pass/Fail
  - Create table of contents from outline

- This list is your **BLUEPRINT** for the commissioning report!
- Use Table of Contents as checklist

Sample Roadmap (Coarse View)

1. Beam Data 1st and 2nd physics in shifts, with 2nd yr resident)
    1. Order of measurement:
        1. Fixed cones
            1. Output Factor (use S:/2013 CK commissioning/OF/fixed.xslx)
            2. TPR (S:/2013 CK commissioning/TPR/TPR_fixed_60mm.xslx)
            3. Profiles (S:/2013 CK commissioning/OCR/OCR_fixed_60mm.xslx)
        2. IRIS (2nd physicist starts processing fixed cone data)
        3. MLC
2. TPS commissioning (2nd physicist & 2nd yr resident, in parallel with machine commissioning)
    1. TG-53
    2. TG-105
3. Machine commissioning (1st physicist & 1st yr resident)
    1. Imaging QA (TG-142)
    2. E2E tests (TG-119)
    3. …

Sample Roadmap (Zoom)

Section 1.1.1.1 Output Factor for Fixed Cone

Estimated Time: 2-3 hours***

Equipment: Water tank, birdcage, SunNuclear Edge S/N, electrometer S/N

Setup: Align robot vertically at 75 cm SSD (use fixed cone front pointer!). Mount diode on birdcage. Verify diode is centered and parallel to surface.

Data Analysis: Use FixedCone.xlsx provided by vendor.

Tolerance: +- 3% to Reference Data Set

---- INSERT PLOT AND TABLE HERE ----

Result: TBD

***How do I figure out how much time it takes?

- When was the last time you did an Annual QA?
- You are a physicist: take data!
- How long does it take **you** to:
  - Set up a water tank
  - Measure PDD for 5 field sizes
  - Measure beam profiles
  - …
- Talk to your peers

Documentation

- Shielding survey report:
  - Needs to be filed with state
  - Response time from state before patients can be treated
  - Need to prioritize measurements and report
- Commissioning report:
  - Use your action plan as blueprint

Who needs what information from you?

- Everyone: **How long will each step take?**
- Physicians:
  - Impact on their patients
  - How to scheduling patients on new machine
  - Training
- RTTs/Schedulers:
  - Day the machine will go down
  - Day the new machine will be up
  - Training