Tour group types and messaging priorities

| Messaging | Young Students | HS/College science | General Public |
| --- | --- | --- | --- |
| Applications | x | x | x |
| Careers | x | x |  |
| Discovery | x | x |  |
| Education | x | x |  |
| Fiscal Responsibility |  |  | x |
| Impressive scale | x | x | x |
| Intro to Nuclei | x | x | x |
| Rare Isotope Production |  | x |  |
| Safety | x |  | x |
| Technical Details |  |  |  |
| World Class | x | x | x |

On a tour, remember to:

* *IN SLIDES: Collect minor form, offer Restroom visit on arrival! Offer group photo*
* *Ask them to ask questions, it’s OK to be overwhelmed*
* Include MORE animations in slides
* Include MORE demos/engagement, ask for volunteers

Talking points by messages

Each message has **animation/demo/engagement**, check demo master list in outreach/events/demo instructions

* + Fiscal Responsibility
    - Reliability/Uptime (**juggling 1, 2, 3 things… 90% of time for 24 hours/day most of the year**)
    - Industry Certifications: environmental quality, operational quality, information security, safety
    - Management/oversight: internal and external reviews of technical advancements, operation, etc. Regular and exhaustive reporting to funding agencies
    - Economic impact (Anderson group estimates): $1B during construction, $1B during first 10 yrs operation
  + Safety
    - Dosimeters – same exposure as background radiation outside
    - Security – IF they ask: as required by law, we have security measures in place, along with the MSU Police. We can’t give details.
    - Relative danger of radiation
  + Risks associated with radiation are less of a concern than risks due to electricity or other industrial hazards.
  + Our most recent NRC inspection showed no violations
  + ALARA: minimize exposure by reducing time, increasing distance, controlling access
  + We all have radiation safety Training, plus many other training to avoid hazards (ladders)
  + **Blocking radiation with material**
    - ZERO Lost-time accidents in 2017, lowest accident rate in last 5 years
    - Our recordable injury rate is lower than university avg, way lower than MI industry
    - Table Est Loss of Life Expectancy NRC regulatory
      * 1 rem/y through working life: 51 days
      * Avg Alcohol consumption: 1 yr
  + Applications
    - Medical
  + **Killing cancer cells with accelerators**
  + Accelerators -> 20 million med procedures/yr
  + **Who’s had an MRI, x-ray, CAT scan, PET scan?**
  + production of medical isotopes
  + sterilizing bandages & medical equipment
    - Geophysics/archaeology
    - Purifying Food & sealing food packaging
    - Careful measurements for quality assurance
    - Power (nuclear plants and deep-space probes)
    - C-14 dating **(dead student)**
    - Smoke detectors
    - Smartphones
    - Save lives and change the world
  + Careers
    - Our research requires a big team! 800+
    - Backgrounds of people at NSCL
  + Psychology, farming, physics, engineering, chemistry, manufacturing
    - Many different skill sets come together to achieve things never done before, and none could do alone
    - If it’s STEM-related, we do it. Also skilled trades (machining, welding, plumbing), business support, education, communications
    - Training in-house
  + World-class
    - Our lab’s major achievements
  + First single-turn extraction cyclotron
  + First superconducting cyclotron
  + World’s highest-energy cyclotron
  + First new-design SRF linear accelerator
  + Cyclotron gas stopper
    - Highest-power heavy-ion beam in the world
    - #1 rare-isotope production in the world
    - #1 nuclear science school in US
    - Serve 1500+ scientists in 50 countries
  + Impressive Scale
    - 300-ton S800
    - Research space 1.5 football fields
    - FRIB linac 3 football fields long, 35 feet down
    - Building >500,000 square feet
    - Power 15-18 MW for FRIB, >$10M/yr
    - Accelerate to 0.5c, four times around Earth/second
    - 3000 gallons of LN/week
    - Tanks for 18000 liters of LHe
    - One room at FRIB has >500 miles of cable
    - FRIB linac 300 cavities at $100K apiece
    - 15 additions since original bldg in 1964
    - Control room reading out thousands of sensors
    - Average Experiment generates 1 TB of data
    - Power/cooling/many complex systems **LN**
    - Different kinds of work/skills needed
    - Exotic environments: equipment at 2K or 4K (-450 F), beamline at 10-6 Torr (billion times less pressure than atmosphere), magnetic fields 100,000x the Earth’s, millions of volts
    - **If wall was the size of the atom, the nucleus would be the width of the crack.**
    - **Marble nucleus football field vote**
    - Other big numbers?
  + Discovery
    - How Detectors measure invisible & short-lived
    - **What could you measure about marble nucleus?**
    - **Put MN inside box - how measure it now?** (scientists can’t just look at and handle the nucleus!)
    - **Weight - interacts with gravity**
    - **Shadow - interacts with light**
    - **Sound - interacts with box**
    - **Can’t see air, but can see wind**
    - **Shape of an invisible object by bouncing off**
    - **Geiger counter, scintillator paddle**
    - Star material (kilonova!)
    - Discovery of isotopes over time
  + Discovered 60 isotopes
  + Discovered bubble nucleus Si-34
  + Discovered di-neutron decay O-26 Be-16
  + Measured mass of a Cu-56 in less than 0.1s
  + Rare isotope production
    - Superconducting magnets **wire sample**
    - how to build an accelerator
    - Fragmentation **frag box**
    - Fragment separation
    - Linear accelerator vs. cyclotron **air track accelerator**
  + Education/Outreach
    - Camps/other
    - #1 nuclear science school in the US
    - 10% of nuclear PhDs in the country
    - Research jobs at NSCL
    - Science Festival
  + Introducing the nucleus
    - Nuclear is one of many sciences
  + **Volunteer – what are you made of?**
    - Energy release from splitting nuclei
    - Parts of an atom
    - Relative size of a nucleus
    - Comparison to LHC?
  + Technical details
    - Beam energy/current
    - Resolution
    - Techniques