SUMMARY:

This white paper summarizes the results of a Fiscal Year 2019 benchmarking survey conducted by the Engineering Practices Subgroup (EPSG) defining details on qualification requirements for specific engineering positions.

PURPOSE:

The purpose of this White Paper was to document which positions typically require site-specific qualifications, document the range of time these can take as well as other information that may be of value to Chief Engineers and their staff who are responsible for establishing and maintaining qualifications for their Engineers. It can also provide insight into how long it may take to either stand up or replace certain engineering positions, as well as possible input on what types of engineering training programs could be useful in the DOE Complex.

SCOPE:

This survey was limited to Chief Engineers and Engineering Points of Contact that participate in EPSG activities. It does represent input from ten sites including two Office of Science, one National Nuclear Security Administration (NNSA) and seven Office of Environmental Management (EM) sites. The groups represented include both large and small sites to provide a range of perspectives. Most benchmark survey questions were open ended to allow maximum data gathering. Specific data was gathered on 16 typical Engineering organization positions, while providing ability of responder to provide additional information on other positions not mentioned.

DEFINITIONS:

No unique definitions.

NARRATIVE:

Benchmark Survey: This benchmarking activity was discussed at April 30-May 1, 2019 meeting. Some input had been gathered prior to the meeting. The benchmark survey was sent to the EPSG mailing list for all Chief Engineers. The cut-off for response was May 24, 2019. Ten responses were received, including input from the Savannah River, Hanford, Oak Ridge/Y12, Los Alamos, Idaho and Argonne sites. Input included two Office of Science, 1 NNSA and 7 EM locations.

Activities represented by the ten respondents included:

- Primarily Design activities (4)
- Primarily Construction activities (3)
- Primarily testing/support activities (5)
- Primarily Operations phase (8)
- Multi-function site (all above phases) (3)

Survey Results:

The following table lists specific Technical Positions where data was requested..

| *Technical Position Title* | *Specific Qualification Exists* | *No Qualification Requirement or no Position* | *Average time for candidate to qualify (If a new hire)* | *Specific Comments* |
|---|---|---|---|---|
| Architect | 1 site | 6 had no qualification; 3 did not have this position title. | None specified | • Pedigree is required as part of the job description, job posting… followed by organization-specific on-boarding training (e.g. MPO)<br>• License from State Registration Board Required at several sites.<br>• See also "Other" |
| Cognizant System Engineer (CSE) | 9 sites | 1 site did not require this position. | Shortest time was 4 weeks (see comments) with up to 2 years.<br><br>Two sites said 3-6 months, two had 1+ years and three said 2+ years | • This is a DOE O 420.1C Position. Minimum 2 years' experience per DOE Training Order.<br>• Several sites had differing levels of CSEs:<br>o 4 Levels of System Engineers, with Level 4 being Cog SE. Level 4 requires 2 yrs experience, with 1 year being nuclear.<br>• Some sites can quickly qualify if they come with required experience. For ;those they just required Class room, On the Job (OJT) Training and Oral Board |
| Design Authority | 9 sites | 1 site did not require any specific qualifications. | Times from as short as 6 weeks to as long as two years were reported. No typical period. | • At some sites this is an 'appointed' position (sometimes even a DOE-designated Key Position).<br>• At other sites Chief Engineer selects based on review of experience, education & credentials (example: PE).<br>• One site uses DAR guidance based on EFCOG and DOE presentations<br>• One site requires CSE experience (over SC/SS active components)<br>• At one site the design authority is the chief engineer<br>• One site requires a minimum of 10 years Engineering experience |
| Designer | 2 sites | 6 sites did not require specific qualifications and another 2 did not have this positon. | Typically Immediately after training requirements are | • Typically based on experience and education (some level of degree).<br>• One site requires minimum education/experience, |

| *Technical Position Title* | *Specific Qualification Exists* | *No Qualification Requirement or no Position* | *Average time for candidate to qualify (If a new hire)* | *Specific Comments* |
|---|---|---|---|---|
| | | | met. One site said typically 3 months. | followed by organization-specific on-boarding training<br>• Another contracts this from approved AE firms with PEs, Architects, etc. which are utilized for specific project. |
| Design Engineer | 4 Sites | 6 sites did not require specific qualifications. | Typically Immediately after training requirements (usually 1-3 weeks) are met. One site said could be up to 4 months. | • Typically based on experience and education (Engineering degree) usually with at least 2 years nuclear related experience.<br>• Another contracts this from approved AE firms with PEs, Architects, etc. which are utilized for specific project. |
| Fire Protection Engineer (or specialist) | 8 sites | 2 sites did not require specific qualifications. | Varied for all sites from as short as 1 week to as long as 2 years. | • See also DOE OSO Letter on Technical Direction Concerning Fire Protection<br>• Most required minimum 2 years' experience, 1 of which is nuclear (standard Technical position in DOE training order)<br>• Several sites base on credentials, experience and oral review.<br>• One requires at least 2-6 years fire protection engineer experience. |
| Maintenance Engineer | 3 Sites | 3 sites did not require specific qualifications and another 4 did not have this positon. | Ranged from 1 month to 1 year. | • Names varied (reliability engineers; plant engineers)<br>• At several sites done by System Engineers<br>• Some only require position for nuclear facilities/activities<br>• One site is starting a new program for Reliability Centered Maintenance Engineering & Asset Management |
| Nuclear Safety Engineer | 8 Sites | 1 site did not require specific qualifications and another 1 did not have this positon. | Ranged from 1 month to 2 years.<br><br>One year most common response. | • Typically only for HC 1, 2, and 3 Facilities<br>• Required experience ranged from 2 years' experience, 1 of which is nuclear to as much as 10 years for Senior NSEs<br>• Often Class room, oral board (Most come w/experience) |

| *Technical Position Title* | *Specific Qualification Exists* | *No Qualification Requirement or no Position* | *Average time for candidate to qualify (If a new hire)* | *Specific Comments* |
|---|---|---|---|---|
| | | | | • Several allowed much more flexibility regarding degree, number of years' experience and type of experience. |
| Plant Engineer | 3 Sites | 4 sites did not require specific qualifications and another 3 did not have this positon. | #6 -Immediately after training requirements are met.<br>#8 – 1 week | • #2: Yes – For the nuclear facilities/activities plus R2A2s for BOP Complex Facility Managers and Facility Engineers<br>• #5: See Other<br>• #6 Based on experience to quality for the position, years and degree |
| Project Engineer | 3 Sites | 4 sites did not require specific qualifications and another 2 did not have this positon. | One site immediately after training requirements are met; another said can take up to 6 weeks. The third site indicated 1 yr. | • Typically based on experience to quality for the position, years and degree<br>• One site requires a minimum of 10 years' experience<br>• Another is in process of developing a specific Training program for Project engineers<br>• See also 'other' |
| Process Engineer | 4 Sites | 4 sites did not require specific qualifications and another 2 did not have this positon. | Ranges from immediately after training requirements are met at low end, up to 2 years | • See Other<br>• Often only based on experience to quality for the position, years and degree |
| Procurement Engineer | 1 Site | 5 sites did not require specific qualifications and another 3 did not have this positon. | The one site typically took one year to qualify | • Typically assigned to SMEs, Engineers, with Quality reviews,<br>• One site has a "Technical representative (~2 weeks to qualify)<br>• Several require this to be done by CSE |
| Shift Technical Engineer | 5 Sites | 2 sites did not require specific qualifications and another 3 did not have this positon. | Ranges from immediately after training requirements are met at low end, up to 1 year | • Not always considered an Engineering Position (e.g. is selected, qualified and reports to Operations)<br>• Often Class room, OJT, oral board<br>• Other sites base on experience to quality for the position, years and degree |
| Systems Engineer | 2 Sites | 5 sites did not require specific qualifications and another 2 did not have this positon. | One data point was 1 year (for 'CSE Light') | • Most sites do not do much value engineering.<br>• Others call CSEs covering non-credited systems by this title |

| *Technical Position Title* | *Specific Qualification Exists* | *No Qualification Requirement or no Position* | *Average time for candidate to qualify (If a new hire)* | *Specific Comments* |
|---|---|---|---|---|
| Test Engineer | 3 Sites | 2 sites did not require specific qualifications and another 4 did not have this positon. | Usually follow levels defined in NQA-1, App. 2A-1<br><br>Others stated typically 1 week (class, required reading) | • Inspectors, calibration techs and engineers, etc. Certified under ISO 17025.<br>• One site has "Test Engineer" and "Senior test Engineer"; difference is in years of experience and evaluation (oral board)<br>• Another stated no specific qualification; usually performed by CSE<br>• One site stated this was not an Engineering position but managed by a separate organization. |
| Welding Engineer | 1 Site | 6 sites did not require specific qualifications and another 2 did not have this positon | One site with a program did not have a specific time. | • One site had R&D welding engineers/experts plus a welding program manager who serves as a welding engineer.<br>• One site said an "SME" based on experience (no specific qualification, and not necessarily an engineer)3<br>• See also Other |
| Other (please specify) | 2 Sites | 3 sites did not require specific qualifications and another 4 did not have this positon. | Can range from a few weeks (for required reading) to up to 2 years | • Some sites have a more generic "Technical Staff Qual" for positions such as Architect, Design, Design Engineer, Project Engineer, or Welding Engineer<br>• One had a Nuclear System Engineer – basically a CSE covering passive credited systems<br>• Other positions mentioned under "Other" include Criticality Safety, Electrical AHJ, "Discipline Lead", Technical Manager, USQ Evaluator, and Process hazards analysis leader qualification. |

The following were specific questions and answers:

a) Do you utilize any of the DOE classes out of Central Training Center (Albuquerque)? If so, which one(s).
Answer: Eight of the ten sites responding did not use any DOE Central Training classes. The few that did included:

- SAF-152DA, Quality Assurance Overview
- Training related to Engineering positions is as follows: ICS 400 (Safety Conscience Work Environment), TLP 150 (Safety Culture Training for Front Line Leaders), TLP-200 (Safety Culture for DOE & DOE Contractor Leaders).

b) As part of your basic training do you provide a general introduction to Conduct of Engineering? If so is it on line, class room or required reading? If a class, how long is it typically?
Answer: Five sites said yes. This included:

- 3 hour classroom/interactive training, specific for site's processes
- One site recently developed a guidance/training module for the basics of Conduct of Engineering – it is based on the EFCOG and DOE presentations give at the NFS Workshop in August 2018. It is targeted at staff who do not necessarily work for/in nuclear facilities but rather in conventional land support facilities.
- Another site placed COE module on all Engineering baseline training
- One site addresses Conduct of Engineering by having Required Reading of select engineering procedures (project specific)

Another four sites stated they did not have a specific Conduct of Engineering training. For those sites:

- At one site, the procedures that comprise the CoE and are specific to a qualification, have a required read for the most part. They do have a separate CGD class where preparers earn a CGD qualification that takes 5 hours.
- Another site with only a small number of CSEs assigns them mentors.
- One site includes some Conduct of Engineering aspects are covered as part of formal HPI classroom training, but for the most part is spread among other general areas including: Lessons Learned, Required Reading, Performance Measures/Metrics, Safety Topics, etc.
- One site does not currently have a separate conduct of engineering course. It is folded into their other courses. However, the intent is present it as an introductory course, estimated to be a 4 hour course.

c) Which positions (if any) do you require Oral Boards for? Written Tests for ? Responses included:

- All positions receive oral board/interview. No written test.
- Specific nuclear-related organizations have this.
- Shift Technical Engineer (STE)– Oral Board (two sites). Some coursework associated with other positions have associated written exams. No comprehensive exams required.
- Criticality Safety Engineers, System Engineers, Fire Protection Engineer
- Written Tests: Technical Reps (like a 'procurement engineer'), STEs, Maintenance Engineers, CSEs. Oral Boards required for: Nuclear Safety, CSEs, STEs, Fire Protection, Test Engineers, Technical Reps
- CSE Oral Boards

- No Oral Boards for any positions. CSE requires an Oral Evaluation that looks like an Oral Board. Written Tests – CSE, Project Engineer, Design Authority and Nuclear Safety Engineer
- Oral Board for CSEs and Oral Check out for Nuclear System Engineers and our Process Engineers.
- One site did not have any oral boards or written tests for any position.

d) Do you have different "levels" in any of your positions (example: Test Engineer I, Test Engineer II, etc.)? If so, what criteria do you use (years experience, additional training, etc.) to differentiate between the different levels?
   - Not really levels but Engineering progression…. Engineer Qualification is prerequisite to becoming Design Authority.
   - Specific for qualified Fire Protection Engineer (QFPE I and QFPE II) meet the minimum education requirements for an Associated Fire Protection Engineer and:
     1) Has at least 18 months of fire protection engineering experience for QFPE I, or
     2) For a graduate of an accredited engineering curriculum or accredited fire protection engineering technology curriculum, not less than 4 years of engineering practice, 3 of which were responsible charge of diverse fire protection engineering work for QFPE II, or,
     3) If not a graduate of an accredited engineering curriculum or accredited fire protection technology curriculum, not less than 6 years of engineering practice, 3 of which were responsible charge of diverse fire protection engineering work for QFPE II.
   - CSEs, Criticality Safety Engineers, and Test Engineers. Years of experience is there primary driver and defined in the Qualification Cards. Test Engineers are as defined in NQA-1, App. 2A-1.
   - Test engineers – based on experience, though the oral interview is more complex for the senor test engineer
   - Fire Protection Engineers (Senior and staff levels), Nuclear Criticality Safety Engineer (Criticality, Analyst, and Shielding at senior and staff levels), both based on additional experience and training
   - Five sites did not have levels for their positions or just normal HR grades for seniority (not tied specifically to a qualification).

e) Do you require any specific certifications from groups outside of DOE for any positions? If so, which outside group and for which position?
   - Six sites did not require any certifications
   - Reliability Engineers are going through Reliability Certification.
   - One site encourages staff to have and maintain a professional engineering license. Although not a hard requirements – the Chief Engineer is now "expected" to hold a PE license. They also require NEC certified inspectors (ref. NPFA 70/NEC) for inspection/approval of subcontractor-installed electrical equipment).
   - Not for lower technical positions, though Design Manager must be registered Engineer in State (to sign permit documents). Cyber Security specialists get certifications but not required when they hire on.
   - None for positions listed in table; yes for Task of Asbestos Project Design; Some Tasks require a PE license.

## CONCLUSIONS:

Most sites had a structured program for training and qualification of their CSEs. For most other positions, the training and qualification varied substantially. The DOE Order covering training requires at least 2 years experience overall with at least one year nuclear experience for a number of technical positions.

## REFERENCES:

1) DOE O 414.1D, Change 1, *Quality Assurance*, May 2013
2) DOE O 420.1C, Change 2, *Facility Safety*, July 2018
3) DOE O 426.2, Change 1, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, July 2013

## Point of Contact if questions:

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