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Changes in OSHA Crane Rules: A Preliminary Look at the Economic Impact on Individual Construction Operations

Bruce W. Smith, CPC
Auburn University
Auburn, Alabama

OSHA published new crane rules on August 9, 2010, which went into effect on November 8, 2010. The new Subpart CC is the first major revision in the crane rules in forty years, and will improve the safety of crane operations. The present study used the OSHA Final Rule document to provide an overview of the development process, causes of accidents, and how causes were addressed. The cost benefit analysis provided by the OSHA Committee showed the impact on the industry, but not individual companies. Construction companies and subcontractors are interested in how compliance to the new rules impact operation costs. The most notable change requires the certification of operators, but other changes in set-up, signaling and rigging may also result in significant costs. Since there are numerous variables in calculating an individual operation or company cost, a template has been developed providing the range of costs associated with specific requirements of Subpart CC. The accompanying explanation of the requirements, and the means of meeting the requirements, provides contractors with a tool for forecasting their potential costs within the range. Future studies can evaluate the actual costs and the benefits associated with the new rules.

Key Words: OSHA Crane, Subpart CC, Compliance Cost, Operator certification

Introduction

The Department of Labor appointed a 23-member committee (Committee) in 2003 to review the crane rules. The Committee represented crane manufacturers, operators, construction companies, safety experts, insurance industry, and government agencies. The work of revising a portion of OSHA 1926 was time consuming and the first document was produced in 2006, reviewed, corrected, and resubmitted in 2008 for review in 2009. Several high profile crane accidents in 2008 emphasized the need to finalize and adopt the new rules. The Cranes and Derricks in Construction: Final Rule, (Federal Register / Vol. 75, No. 152 (FR-75-152) was published on August 9, 2010, and became effective on November 8, 2010. The Final Rule created a new 29 CFR 1926 Subpart CC (OSHA Final Rule 2010).

The starting point for the Committee was to define the causes of accidents and fatalities in order to understand where changes were needed. Once the causes were identified, work groups defined solutions and combined them into a new Subpart. As part of the analysis of the solutions, the Committee quantified the cost and the benefit of the new rules to define the economic impact of implementing the new rules.

The cost, or economic impact, of the new rules was based on the North American Industry Classification System (NAIC) to identify which industry classifications would be impacted, number of firms in each category, the number of employees, revenues, and profits. Then costs to the U.S. construction industry were estimated based on the changes in the rules. Companies need to have a basis for defining costs to their individual operations. The development of a template can facilitate projecting project costs. As the industry and individual operators compile experience data, the costs will become part of the operational data. The challenge is allocating costs for one to five years, before operators have solid experience data.

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Due to the number of variables, the template provides a range of costs that can be applied to different portions of the new rules. Some parts of the new rules are very broad as to methods of compliance, that projecting a range is not appropriate. The template is only intended as a starting place that combined with the explanations of possible methods of compliance provides a usable tool. An example is used to show how the template can be used.

Background

The Committee used two studies to identify the problem areas. Table 1 shows the results of a study by Suraha et al. of crane incidents resulting in deaths from a period of 1984 to 1994. Table 2 shows the results of study by Beaver et al. published in 2006 on causes of fatalities during the performance of hoisting operations during the period from 1997 to 2003.

The two studies used some different categories and the percentages differed, but did provide a comprehensive assessment of the causes for crane fatalities the Committee needed. The studies identified issues that needed to be addressed to improve the crane safety from assembly, through operations, and to disassembly.

Table 1

The Causes of Crane Incidents Resulting in Deaths

Causes of Incidents	Percent of Total
Electrocution	39%
Crane Assembly and Disassembly	12%
Boom Buckling / Collapse	8%
Crane Upset/Overturn	7%
Rigging Failure	7%
Overloading	4%
Struck by a Moving Load	4%
Accidents Related to Man-lifts	4%
Working Within Swing Radius of Counterweights	3%
Two-Blocking	2%
Hoist Limitations	1%
Other Causes	6%

(Suruha et al. 1997)

Table 2

The Causes of Fatalities During the Performance of Hoisting Activities

Causes of Fatalities	Percent of Total
Struck by Load (other than failure of boom/cable	32%
Electrocution	27%
Crushed during assembly/disassembly	21%
Failure of Boom/cable	12%
Crane tip-over	11%
Struck	3%
Falls	2%

(Beavers et al. 2006)

Table 3 uses the categories of the Suraha study because of the additional categories, and provides an overview of how the Committee responded to the identified hazards. The responses were both changes and additions. One change responded to electrocution. The previous rules required cranes work a minimum of ten feet from energized power lines. The number of incidents made it clear that the distance was not sufficient, so the distance was changed

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to twenty feet. Although strict adherence to the previous rule may have been sufficient, the new distance provides an added margin of safety with costs attached. Additions include responsibility for Ground Conditions and the establishment of an Assembly/Disassembly Director (OSHA 1926, 2011).

Table 3

Subpart CC Responses to the Causes of Crane Accidents

Causes	Responses
Electrocution	Increased distance from 10 to 20 ft. from energized lines.
Crane Assembly and Disassembly	Rules on Assembly and Disassembly: Added inspection before and after assembly, assembly plan, competent/qualified person, qualified workers, and the establishment of an Assembly Director
Boom Buckling / Collapse	Training and Certification of Operators and Authority to Control lifting operations
Crane Upset/Overturn	Requirements and responsibility for ground conditions and Certification of Operators
Rigging Failure	Inspection of rigging and qualification of riggers
Overloading	Training and Certification of Operators and Authority to Control lifting operations
Struck by a Moving Load	Training and Qualification of Signalers and Establishing the “fall zone”
Accidents Related to Man-lifts	New rules on Man-lifts
Working Within Swing Radius of Counterweights	No change from current rules – Swing radius must be marked and protected.
Two-Blocking	Requiring Two-Block safety devices.
Hoist Limitations	Training and Certification of Operators and Authority to Control lifting operations
Other Causes	No specific rules

(OSHA 1926, 2011)

The new rules are contained in a new subpart of CFR 1926 called Subpart CC, Cranes and Derricks in Construction. The previous Subpart N, Cranes, Derricks, Hoists, Elevators, and Conveyors has been modified and retitled Helicopters, Hoists, Elevators and Conveyors. Table 4 compares the length of each section, indicating the level of detail dedicated to each topic. The table shows that many areas covered by Subpart CC were not addressed prior to November 10, 2010.

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Table 4

Comparison of the Scope of Rules in Subpart N and Subpart CC

2010 - Subpart N 1926.550	2011 - Subpart CC 1926.1400
Operator Qualification - nothing	Operator Qualification – 3 pages
Floating cranes - nothing	Floating cranes – 3 pages
Signaling – 1 paragraph	Signaling – 1 pages
Rigging - nothing	Qualified Riggers – 3 references
Wire Rope – 1 paragraph	Wire Rope – 2 pages
Ground Conditions - nothing	Ground Conditions – 1/2 page
Assembly and Disassembly - Nothing	Assembly and Disassembly – 3 pages
Power Lines – ½ page	Power Lines – 6 pages
Inspections – 2 paragraphs	Inspections – 6 pages
Tower Cranes – 5 paragraphs	Tower Cranes – 3 pages

(OSHA 1926, 2010, OSHA 1926, 2011)

The Committee investigated the cost of and potential benefits associated with the implementation of Subpart CC. The cost, or economic impact, of the new rules was based on the North American Industry Classification System (NAIC) to identify which industry classifications would be impacted, number of firms in each category, the number of employees, revenues, and profits. Each of these classifications was broken down further to derive more accurate information. Table 5 shows the anticipated costs and benefit for the implementation of Subpart CC.

As an example, the Committee looked at of operator certification. The committee used a cost of $2064 per operator certified, for a total cost to the industry of $50.7 million. The $2064 represents $1500 a test preparation course, including the $250 for the exam itself, and 18 hours of wages of $564 (OSHA Final Rule 2010).

Table 5

Annual Benefits, Costs, and Net Benefits, 2010 Dollars

Annualized costs	
Crane Assembly/Disassembly	$16.3 million
Power Line Safety	$68.2 million
Crane Inspections	$16.5 million
Ground Conditions	$2.3 million
Operator Qualification and Certification	$50.7 million
Total Annualized Costs	154.1 million
Annualized Benefits	
Number of Injuries Prevented	175
Number of Fatalities Prevented	22
Property Damage from Tip-overs Prevented	$7 million
Total Benefits	$209.3 million
Annual Net Benefits	$55.2 million

(OSHA Final Rule 2010, OSHA Office of Regulatory Analysis)

The benefit side came from information solicited from insurance companies and used an accident reduction rate of 25%, showing a decrease in claims paid based on historical data. Ontario, Canada, adopted training and certification of operators in 1979. Between 1969 and 1979, Ontario experienced and average of 8.5 crane related fatalities per year. Fatalities have declined between 1991 and 2002, to an average.75 per year (CSAO). Another study conducted by Cal-OSHA shows an 80% decrease in the number of fatalities due to crane accidents since the state began

requiring operator certification in 2005 (California 2009). The Committee's forecast of a 25% reduction in crane related accidents, injuries, and fatalities, would be conservative based on the Ontario and California experience.

Economic Impact on Individual Operations

Breaking out costs for employers or crane owners requires examining the components of operations costs that relate to crane safety, and more specifically, OSHA requirements. The "Individual Operations", for the following discussion, is defined as the operation of a single crane over the course of one year. The economic impact of the new requirements of Subpart CC will be restricted to Operator Qualification and Certification, Crane Assembly and Disassembly, Annual Crane Inspections, Ground Conditions, Power Line Safety, Signal Person Qualification, Rigger Qualification, and Communication Devices

The average economic impact of Subpart CC on an individual operation is difficult to forecast due to the number of variables and the impact of each variable. Each contractor must review their current operations, understand the new rules, define the changes that are required, and assign an appropriate cost to each of the changes.

As an example, a construction company which specializes in steel erection, owns their own equipment, already has mandatory crane inspection, certified operators, qualified assembly and disassembly directors (but may use another term), qualified riggers, and qualified signalers, will realize very little increase in cost.

The following discussion will point out what costs may be incurred and provide a range of annual costs that may be incurred. Each operator will use the information to make an educated decision on where their specific costs fall within the range. Some areas, such as Power Line Safety, do not apply to many jobsites, while other contractors are working with energized lines daily. Table 6, the summary worksheet, does not give a range, but indicates that each operation will need a separate determination, indicated by "To Be Determined" (TBD).

Operator Qualification and Certification

Perhaps the most dramatic section of Subpart CC is the requirement for operator qualification/certification. Certification of operators is required by November 10, 2014. Subpart CC specifies that the cost of operator qualification and certification will be borne by the employer (OSHA 1926 Subpart CC). The cost of certification will depend on a number of factors, but the written portion starts at $200, with specialty exams that can be added. The practical examinations start at around $300 and go up. Prep courses for the exam run from $800 to $1500. The prep courses are designed to prepare qualified operators to pass the written and practice parts of the exam. An additional course to train new or intermediate operators to be qualified operators cost from $1000 to $3000. In addition, operators need to have a physical exam and are paid for the time they are training and taking the exam. Employers may also incur travel, housing, and meals expenses. In summary, the cost to certify an operator would range from $500 for a test ready, experienced operator, to several thousand for an inexperienced operator. The certification is valid for five years (NCCCO).

Assembly and Disassembly

Most of the section addresses specific procedures. The economic impact may come from the requirement for a competent-qualified person, to be called the Assembly/Disassembly Director (A/D Director). This could be one person, who is competent according to the OSHA definition of a Competent Person, and qualified. There can also be two or more people to fulfill the requirement, with the competent person being assisted by one or more qualified persons (OSHA 1926 Subpart CC).

1926.1404(2) (b) and (c) states that the qualified person must understand the applicable assembly/disassembly procedures, including configuration and accessories. The Federal Register (OSHA Final Rule) states that the procedures to be used are the manufacture's procedures, unless the employer's procedures meet the requirements of 1926.1406 (Employer's Procedures – General Requirements).

The cost will vary based on the resources available to the employer. Assuming the qualified person is a manufacturer's representative or a professional engineer experience in crane assembly, the cost could range from $300 to $1000 per day. The A/D Director is required each time the equipment changes sites or is modified (including "jumping" tower cranes) (OSHA 1926 Subpart CC). A crane rental or leasing company may have persons on staff who meets the OSHA guidelines for an A/D Director.

Cost for the A/D Director, depending on the size of the crane and the number of days to assemble, modify (jumping), and disassemble, could range from no additional costs for those companies currently using competent and qualified persons, to $10,000 for companies who will need to hire outside expertise. The costs need to be calculated on "assembly/modification/disassembly" basis occurring during the year.

Crane Inspections

Inspections requirements have been broadened. There is now a requirement for a pre-assembly and post-assembly inspection performed by a qualified person using the equipment manufacturer's criteria. This inspection includes functional testing. In most cases, the A/D Director would complete this inspection.

The competent person is required to make inspections before each shift and monthly. The requirements for the monthly inspection are the same as the shift inspection, but need to be documented. The documentation must include the name and signature of the person inspecting, along with the items checked and the results.

An annual inspection must be performed by qualified person and involves some disassembly. Subpart CC provides the minimum checklist for the inspections. The documentation need to be maintained until the next inspection. Subpart CC indicates the qualified person does not need to be a third party, but the inspector needs to be qualified, and the inspection procedure must be developed and audited for companies seeking to perform their own annual inspections (OSHA 1926 Subpart CC).

Most companies are currently performing, shift, monthly, and annual inspections in compliance with pre-Subpart CC rules. The intensity of the inspections will increase, as will the time for the competent person and the qualified person to perform them.

Additional costs would usually stem from the annual inspection. Whether the inspection is performed by a third party or a staff person, additional manpower and equipment is required to disassemble certain areas to properly inspect, including inspecting the entire length of each wire rope. An inspector, two workers, and necessary equipment will cost about $1500 per day for most construction cranes. Larger cranes will need to price the annual inspections accordingly.

Ground Conditions

Ground conditions were not addressed in the old Subpart N. Subpart CC has placed responsibility for ground conditions on the "Controlling Entity," which is defined as "… a prime contractor, general contractor, construction manager, or any other legal entity which has the overall responsibility for the construction of the project…" The ground conditions rule may or may not result in additional cost for the crane operator, but it may add project costs. Subcontractors with hoisting requirements should verify who managing the ground conditions for the project in case those costs are being assigned to subcontractors by the controlling entity (OSHA 1926 Subpart CC).

Power Line Safety

Subpart CC has expanded the section of power line safety. Employers working near power lines will see changes in the operations due to the increased minimum distance from 10 feet to 20 feet. The rule also requires designated qualified spotters when a crane is working within the 20 foot bubble around a power line. A qualified spotter must have no other duties while the crane is in operation, and must be in constant contact with the crane operator, whether visually or by radio (OSHA 1926 Subpart CC).

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The cost from Table 5 shows annual costs of $68.2 million. These costs are based on cranes working within the 20 feet distance around a power line. Cranes working within this zone must: employ an insulating link on the hoist line, have utilities or professional engineers overseeing de-activation of power lines, conduct planning meetings (Required), make requests to de- activate and re-energizing, employ barricading, provide a dedicated spotter at all times when working within the 20 foot zone.

The cost for compliance will depend on the extent of the operations and qualification of the workers. The Committee estimated that about 8% of lifting operations would be impacted by this cost (OSHA Final Rule 2010). Since this is a specialized application, and not encountered on many construction sites, and the costs are largely situation reliant, the costs will not be discussed. Contractors who are impacted by this rule need to review their procedures and calculate costs accordingly. This is potentially the largest cost of Subpart CC for the contractors who are impacted.

Signal Person Qualification

Subpart CC requires that all signal persons must be qualified. The signal person is considered qualified if he or she:

- Knows and understands the type of signals used on the worksite
- Is competent in using the signals
- Understands the operation and limitations of the equipment, including crane dynamics involving swinging, raising, lowering, and stopping loads, and boom deflection from hoisting loads
- Knows and understands the relevant signal person qualification requirements.
- Passes an oral or written test, and a practical test (OSHA 1926 Subpart CC).

Employers may use qualified third-party trainers or use an in-house qualified evaluator. The National Commission for the Certification of Crane Operators (NCCCO) has a "Test Site Coordinator Handbook" for evaluators (trainers) to administer the NCCCO written and practical examinations. Employers must make the documentation available at the worksite. The documentation must specify each type of signaling for which the signal person is qualified (OSHA 1926 Subpart CC).

Training for qualified signal persons should last a minimum of four hours, and the cost per signaler will vary with the number trained together. At a minimum, with an in-house qualified evaluator, each signaler will cost at least 4 hours of time or about $120 (OSHA Final Rule 2010). A third party trainer for a two day signaling and rigging class will cost $565 plus employee expenses (Crane Institute).

The key to the cost on the signalers is how many signalers are going to be on the project and who they work for. Different trades or subcontractors may utilize the same crane. Crane operators have the final decision on when a signaler is required. The final cost to an operation may be quite low with training a few signalers, to quite high with the use of dedicated signalers, with no other tasks. Contractors must evaluate their own operation and system in order to arrive at a cost.

Rigger Qualification

Subpart CC defines a "Qualified Rigger" as rigger that meets the criteria for a "Qualified Person." A "Qualified Person" is a person who, "… by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, or experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project (OSHA 1926 Subpart CC)." The NCCCO offers training and certification. The level of training required will be based on the complexity of the rigging problem. Whoever is rigging a lift should be trained on the specific task, and the training documented (NCCCO). Advanced rigging training starts a $295 for one day (Crane Institute)

On many sites, the riggers will also be the signal persons and have concurrent training at $565 for two days (Crane Institute). As a result the anticipation of the cost is going to depend on the current level of certification and the organization of the jobsite. Steel erection crews are generally trained in rigging and signaling and would sustain little additional cost other than documentation. A jobsite with a crane provided by the general contractor and used by many subcontractors will need to have procedures that will insure that only trained riggers are securing loads and there is a method for the operators to identify qualified riggers and signalers.

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Communication Devices

Subpart CC requires that operators have "hands-free communication." Certain communication devises now in service will need to be replaced by units that allow two-way, hands-free, multiple user devices. The cost for these sets range from $500 to $3000, and it could be assumed that a set would have a one year life due to the working conditions (PWC 2011)

Results

The proceeding discussion provides a basis for contractors to project their costs. Table 6 is a template to consolidate the information and arrive at projected costs. In some cases, a range of costs is provided, but in others, there are too many variables and each operator will need to apply the costs to conditions. The analysis does give a starting point that contractors can use to make their own evaluation. Contractors can use Table 6 and the above information on how the line item costs are derived, apply them to their own operation, and come up with a cost that can be allocated to the operation of each piece of equipment. As the industry and individual operators compile experience data, the costs will become part of the operational data. The challenge is allocating costs for one to five years, before operators have solid experience data.

As a theoretical example, a company is building a cast-in-place concrete parking deck using a large lattice boom crawler crane. The operator certification cost is the yearly average, the crane will assembled and disassembled one time, ground condition costs are estimated at $10,000, inspections will cost $2000, there are no power line issues, ten workers are going to trained as riggers/signalers, and one new communication set will be purchased. A total of $28,650 will be used as part of the job costs

Table 6

Projecting Annual Additional Costs for Compliance to Subpart CC

	Range of Costs	Your Cost
Operator Qualification and Certification	$500 to $1600	$500
Crane Assembly/Disassembly	$0 to $10,000	$10,000
Daily, Monthly, Annual Crane Inspections	$1500 and up	$2,000
Ground Conditions	TBD	$10,000
Power Line Safety	TBD	0
Signal Person Qualification	TBD	$5,650
Rigger Qualification	TBD	Included in rigger/signaler training
Communication Devices	$0 to $500	$500
Total		$28,650

Conclusion

The Committee was rigorous in defining the problem, coming up with solutions, and anticipating the overall cost to the industry, complemented by the anticipated benefits. It will take years of data to evaluate the cost and benefit of the changes. This is a preliminary study, but it has provided a starting point for contractors to evaluate the potential costs and use these cost in future project estimates. It became clear to the author that accurate projections of the cost was difficult due to the number of variables, but the value came in identifying the source of the costs. One significant point was that the long term cost for the certified operators may be less that the cost of qualified riggers and signalers.

There are several directions to go from this point. First will be the application of the template to specific operations and use these case studies as a basis for defining new studies. The case studies may allow the classification of

operations so costs can be more accurately defined. The second would be gathering information from the industry in a larger survey. The larger survey could provide information on methods of compliance as well as cost.

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