EARTHQUAKE PERFORMANCE RATING SYSTEM
USER'S GUIDE

Prepared by
The Building Ratings Committee
A sub-committee of the Existing Buildings Committee of
The Structural Engineers Association of Northern California

February 2, 2015

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Acknowledgments

This User's Guide was written by members of SEAONC's Building Ratings Committee (BRC), as a subcommittee of the SEAONC Existing Buildings Committee.

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1. The Rating Process: Using the EPRS User's Guide

The Earthquake Performance Rating System (EPRS) was developed by the Structural Engineers Association of Northern California (SEAONC) Building Ratings Committee (BRC), a sub-committee of SEAONC's Existing Buildings Committee (EBC), to improve the practice of seismic evaluation and seismic risk communication. The BRC has developed this User's Guide to explain the EPRS and to assist users in producing a rating.

The EPRS is not itself a seismic evaluation methodology. The EPRS is primarily a set of definitions intended to improve existing engineering practices with respect to communicating earthquake risk to non-expert stakeholders.

All EPRS users should understand the recommended process for producing an EPRS Rating (Chapter 1), the essential features of the EPRS (Chapter 2), and the documentation recommended to accompany a rating (Chapter 3). Each of these topics is discussed further in Appendix A.

Producing an EPRS Rating involves the following basic steps:

1. Complete a seismic evaluation using a separate methodology.
2. Translate the findings of the evaluation into a three-part EPRS Rating.
3. Present the rating.

1.1. Qualified raters

The EPRS, like any building assessment tool, should be applied by qualified individuals. The BRC developed the EPRS with the expectation that it would be applied primarily by licensed civil or structural engineers experienced in building evaluation or design. However, the enforcement of qualifications is left to others. It is expected that clients or other stakeholders might develop and implement specific qualification measures to suit their own purposes.

1.2. Engineering judgment

All engineering, including seismic evaluation, involves judgment. When deriving an EPRS Rating, appropriate engineering judgment should be applied during the application of the underlying evaluation methodology (see Section 2.1), not during the translation of evaluation findings into a rating. Engineering judgment should only be applied by the engineer who performs the underlying evaluation. Where applied, judgment should be identified clearly in the supporting documents (see Section 3.2).

1.3. Quality control

In general, each engineer is responsible for the quality of his or her EPRS Rating, just as he or she would be responsible for the quality of the underlying seismic evaluation. It is expected that clients or other stakeholders might develop and implement specific quality control measures to suit their own purposes.

2. The Rating System: Essential Features of the EPRS

The EPRS is a new tool, but it is related to existing engineering tools, procedures, and professional practices. Therefore, proper use of the EPRS demands an understanding of what it is intended to do, how it was developed, and how it is expected to work.

This Chapter briefly notes certain essential features of the EPRS. Further explanation and discussion is provided in Appendix A and in the listed References (especially SEAONC EBC BRS, 2012).

2.1. Underlying evaluation methodologies

Because the EPRS is not itself a seismic evaluation methodology, it does not replace any methodologies currently used to evaluate buildings. Rather, the EPRS is intended as a means to supplement a separate, or underlying, evaluation with a rating that summarizes and simplifies the evaluation findings in consistent EPRS terms.

It is the intent of the BRC that separate documents, or guides, will be produced to translate the results of underlying evaluations into EPRS terms. At present, the BRC has developed a complete procedure (SEAONC EBC BRC, 2015) for the national standard known as ASCE 31-03 (ASCE, 2003).

It is not the intent of the BRC to prohibit the use of any evaluation methodology, including informal, simplified, or judgment-based methodologies. However, it is the intent that EPRS Ratings would be derived using consensus procedures specific to each underlying methodology.

2.2. Seismic hazard

EPRS Ratings are intended to correspond to expected performance given a single earthquake with ground shaking between 75 and 100 percent of that used for the design of a new building of normal occupancy (Risk Category II) and of similar size and location.

2.3. Rating scope

EPRS Ratings do consider the performance of:

- Structural components
- Nonstructural components
- Fixed equipment specifically identified by the rating engineer
- Non-building structures associated with and immediately adjacent to the building
- Adjacent buildings (as falling and pounding hazards only)
- Geologic conditions within the building lot.

EPRS Ratings do not consider the performance of:

- Utilities or infrastructure outside the building footprint
- Most building contents routinely supplied or removed when tenants change
- Geologic conditions outside the building lot
- Externalities that commonly affect repair costs or recovery times

Variations from the basic scope should be identified clearly in the supporting documents (see Section 3.2).

2.4. Rating definitions

Table 2.4 gives the definitions of EPRS Rating levels for each of three rating dimensions: Safety, Repair Cost, and Recovery. Each level has a symbolic representation (one to five stars), a short name or label meant to convey the basic meaning of each distinct level, and a longer description intended to explain the short label in terms closer to those used by engineers and by underlying evaluation methodologies.

EPRS ratings are intended to correspond to expected performance given the seismic hazard described in Section 2.2.

Table 2.4. EPRS Rating Levels defined for each of three rating dimensions

Safety	
★★★★★	**No entrapment.** Expected performance would not lead to conditions commonly associated with earthquake-related entrapment.
★★★★	**No injuries.** Expected performance would not lead to conditions commonly associated with earthquake-related injuries requiring more than first aid.
★★★	**No death.** Expected performance would not lead to conditions commonly associated with earthquake-related death.
★★	**Death in isolated locations.** Expected performance in certain locations within or adjacent to the building would lead to conditions known to be associated with earthquake-related death.
★	**Death in multiple or widespread locations.** Expected performance as a whole would lead to multiple or widespread conditions known to be associated with earthquake-related death.
NR	**No rating.** The rating methodology does not justify or support a Safety Rating, or no Safety Rating was requested.

Repair Cost	
★★★★★	**Within typical operating budget.** Expected performance would lead to conditions requiring earthquake-related repairs commonly costing less than 5% of building replacement value.
★★★★	**Within typical insurance deductible.** Expected performance would lead to conditions requiring earthquake-related repairs commonly costing less than 10% of building replacement value.
★★★	**Within industry Scenario Expected Loss (SEL) limit.** Expected performance would lead to conditions requiring earthquake-related repairs commonly costing less than 20% of building replacement value.
★★	**Repairable damage.** Expected performance would lead to conditions requiring earthquake-related repairs commonly costing less than 40% of building replacement value.
★	**Irreparable damage.** Expected performance would lead to conditions requiring earthquake-related repairs commonly costing more than 40% of building replacement value.
NR	**No rating.** The rating methodology does not justify or support a Repair Cost Rating, or no Repair Cost Rating was requested.

Recovery (excluding externalities)	
★★★★★	**Within hours.** Expected performance would support the building's basic intended functions within hours following the earthquake.
★★★★	**Within days.** Expected performance would support the building's basic intended functions within days following the earthquake.
★★★	**Within weeks.** Expected performance would support the building's basic intended functions within weeks following the earthquake.
★★	**Within months.** Expected performance would support the building's basic intended functions within months following the earthquake.
★	**Within years.** Expected performance would not support the building's basic intended functions within a year following the earthquake.
NR	**No rating.** The rating methodology does not justify or support a Recovery Rating, or no Recovery Rating was requested.

Four essential features of the EPRS are reflected in these definitions:

1. <u>Three separate dimensions</u>

Currently, the three dimensions, or components, of an EPRS Rating are Safety, Repair Cost, and Recovery.

- The Safety Rating addresses the physical health and safety of building occupants during the earthquake shaking and through egress.
- The Repair Cost Rating addresses the financial loss associated with repairs needed to restore the pre-earthquake condition.
- The Recovery Rating addresses the time needed to restore the building's capacity to support the basic intended functions of its pre-earthquake use and occupancy. Thus, Recovery here means "functional recovery," as opposed to reoccupancy or full recovery.

The three dimensions are conceptually independent, so a 3-star Safety Rating, for example, does not imply and is not implied by a 3-star Repair Cost Rating or a 3-star Recovery Rating.

The BRC encourages presentation of all three dimensions even if No Rating is given for one or two of them, as this communicates to clients and other stakeholders that earthquake performance is increasingly about more than safety or economic loss.

2. <u>Five levels within each dimension</u>

The five rating levels are expected to capture practically all of the current building stock. However, it is neither the intent nor the expectation that the five rating levels represent equal portions of the building population. Rather, the BRC expects the highest rating levels to be assigned only rarely and only where the building's design explicitly sought exceptional performance relative to a typical new building of normal occupancy.

3. A "No Rating" option

In addition to the five rating levels, each dimension has a "No Rating" option for cases where the underlying methodology does not justify or support a specific rating. The No Rating option may also be used where a rating for that dimension is not required for the rating program. (See Section 2.6: Specialized ratings.)

4. Pragmatic distinctions between levels

Where industry and regulatory precedents exist, the rating levels are set to respect them. Otherwise, the rating levels are intended to respect the perspective of rating users (owners, tenants, lenders, regulators), as opposed to more academic or theoretical perspectives of some engineers and researchers.

2.5. Translating the underlying evaluation

The heart of the rating process is the translation of underlying evaluation results into an EPRS Rating. A translation procedure should be suited to the underlying evaluation methodology. The more formal the evaluation methodology, the more detailed and specific the translation procedure will likely be. In all cases, however, an EPRS rating is a simplified summary of the evaluation findings, so it will almost always present less certainty and less detail than the underlying evaluation. Translation of evaluation findings to EPRS Ratings is therefore best thought of as the process of selecting not the perfect description of expected performance, but the best description from among five available choices.

A detailed translation procedure for any formal, documented evaluation methodology will respect the eligibility limits, the required scope of work, and the performance assumptions and descriptions given by the methodology itself. Where the methodology is incomplete as to its performance definitions, the translation procedure will include the judgment of the BRC or other organizations that develop the procedure. In these cases the No Rating option may be the best choice.

Currently, the BRC has developed one complete translation procedure, for ASCE 31-03 (SEAONC EBC BRC, 2015). It is the BRC's intent that procedures for other evaluation methodologies will be developed and provided in future guides. Again, however, it is not the intent of the BRC to prohibit the use of any evaluation methodology, including informal, simplified, or judgment-based methodologies.

2.6. Specialized ratings

By addressing a broad range of potential earthquake performance in three quasi-independent dimensions, the EPRS is more comprehensive than most specialized evaluation methodologies and rating systems in use today. Nevertheless, the BRC recognizes that many rating programs will not need so detailed an approach. While a three-part rating is more complete and in many cases more clear, and while the BRC encourages engineers to use the EPRS as a recommended practice, specialized ratings might better serve the immediate needs of certain clients or other stakeholders. Specialized ratings might involve only some EPRS dimensions and levels and might give certain combinations of rating levels their own designations.

These specialized ratings can be derived from the more comprehensive EPRS. It is the position of the BRC that rather than replace the EPRS, specialized ratings should be built from it and linked back to it, so as to maintain the benefit of a common set of ideas and definitions.

3. The Rating Presentation

An EPRS Rating should be communicated in a way that supports its goal of clear and effective communication to non-expert stakeholders. These guidelines for presenting an EPRS Rating to a client or user are important because the EPRS as a defined system is new, even if its concepts are familiar and pragmatic.

The BRC anticipates at least two levels of presentation, as outlined in the following sections.

Regardless of presentation type, format, or content, the presentation should not refer to SEAONC in any way that might give the impression that SEAONC produced or reviewed the rating.

3.1. Summary presentation

When delivering an EPRS Rating to the client, the rating engineer should use the full presentation described in Section 3.2. The summary presentation is intended merely as an optional (but recommended) cover sheet, with the expectation that the client might post or forward just the summary, without all of the supporting documents that are part of a full presentation. The summary presentation is expected to fit on one side of a standard 8.5x11 sheet.

The BRC recommends that a summary presentation include all of the following:

- A building identifier. This can be the street address, the client's name for the building, or any designation that uniquely identifies the building being rated.

- The three-part rating, showing each rating dimension and the symbolic rating (the stars or "NR" for No Rating; see Table 2.4) for each dimension. It is important that each dimension – Safety, Repair Cost, Recovery – be shown with its own rating, as opposed to showing a single rating for all three dimensions together.

- The rating engineer's seal, which should show the engineer's name and license number.

- The rating engineer's signature.

- The date of the signature and seal, which may be taken as the effective date of the rating.

- The full set of EPRS Rating definitions, from Table 2.4, including the symbol, the name, and the definition of each rating level for each rating dimension.

- The underlying methodology used to derive each dimension's rating.

In addition, the BRC recommends including the following statement (or something similar, at the rating engineer's discretion) for completeness (see also Sections 2.2 and 2.3):

> These ratings correspond to expected performance given a single earthquake with ground shaking between 75 and 100 percent of that used for the design of a new building of normal occupancy (Risk Category II) and of similar size and location. The rating does not address the performance of certain contents, utilities, infrastructure, or

geologic conditions outside the building footprint or lot. See the EPRS User's Guide for a full description of the rating scope.

3.2. Full presentation

The full presentation represents the BRC's recommendation for the minimum amount of information that a rating engineer should deliver to the client.

The BRC recommends that a full presentation include all of the following:

- A summary presentation, or all of the information required for a summary presentation, as described in Section 3.1.
- Any summary or report form contractually required by the client or the organization or agency implementing the EPRS.
- The EPRS translation. This is a report showing how the EPRS Rating was derived from the underlying evaluation. Where a formal translation procedure exists, this report might take the form of that procedure, with any flowcharts or worksheets provided there.
- The underlying evaluation report. The format and content of the underlying evaluation report will vary with each methodology. In general, a report should be sufficient to show how its results were produced and where the judgment of the evaluating engineer, if any, was applied (see Section 1.2). The BRC recommends including a summary of the underlying evaluation showing the results used as inputs to the EPRS translation procedure.

References

Almufti, I. and Willford, M., 2013. *REDi Rating System: Resilience-based Earthquake Design Initiative for the Next Generation of Buildings* (version 1.0), ARUP, October.

ASCE, 2003. Seismic Evaluation of Existing Buildings (ASCE/SEI 31-03), American Society of Civil Engineers.

ASCE, 2006. *Seismic Rehabilitation of Existing Buildings* (ASCE/SEI 41-06), American Society of Civil Engineers.

ASCE, 2012. *Seismic Evaluation and Retrofit of Existing Buildings: Pre-publication Edition for Public Comment and Final Review* (ASCE/SEI 41-13), American Society of Civil Engineers.

ASTM, 1999. E 2026 – 07, "Standard Guide for the Estimation of Building Damageability in Earthquakes," 1999, American Society for Testing and Materials.

ASTM, 2007. 2557-07, "Standard Practice for Probably Maximum Loss (PML) Evaluations for Earthquake Due-Diligence Assessments", 2007, American Society for Testing and Materials.

ATC, 2011. ATC-71-2, "Proceedings for a Workshop on a Rating System for the Earthquake Performance of Buildings," May 2011, Applied Technology Council.

ATC, 1997. ATC-20, "Procedures for Post-Earthquake Evaluation of Buildings," 1997, Applied Technology Council.

Bonowitz, D., 2011. "Resilience Criteria for Seismic Evaluation of Existing Buildings," Report to Structural Engineers Association of Northern California, August 5.

FEMA, 2002. *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook, Second Edition* (FEMA 154), Federal Emergency Management Agency, March.

ICC, 2012. *International Existing Building Code*, International Code Council.

Risk Engineering, Inc., 2012. ST-RISK, www.st-risk.com.

SEAONC Existing Buildings Committee, Building Ratings Subcommittee, 2008. "Report Cards for Buildings: A Proposed Rating System for Earthquake Performance," Proceedings, 77th Annual Convention, Structural Engineers Association of California.

SEAONC Existing Buildings Committee, Building Ratings Subcommittee, 2009. "Report Cards for Buildings: A Proposed Rating System for Earthquake Performance," in *Proceedings of the 2009 ATC&SEI Conference on Improving the Seismic Performance of Existing Buildings and Other Structures*, San Francisco, December 9-11.

SEAONC Existing Buildings Committee, Building Ratings Subcommittee, 2011. "SEAONC Rating System for the Expected Earthquake Performance of Buildings," Proceedings, 80th Annual Convention, Structural Engineers Association of California.

SEAONC Existing Buildings Committee, Building Ratings Subcommittee, 2012. "SEAONC Earthquake Performance Rating System: Translating ASCE 31-03," SEAOC 2012 Convention Proceedings, Structural Engineers Association of California.

SEAONC Existing Buildings Committee, Building Ratings Committee, 2015 (in review). "Guide for deriving an EPRS Rating from an ASCE 31-03 Evaluation," Structural Engineers Association of California.

Appendix

Appendix A. EPRS Background and Discussion

Appendix A. EPRS Background and Discussion

The following sections provide background and discussion regarding the development of the EPRS and the intent and expectations of the BRC regarding its use. The User's Guide provisions are shown in boxes followed by the corresponding commentary.

1. The Rating Process: Using the EPRS User's Guide

The Earthquake Performance Rating System (EPRS) was developed by the Structural Engineers Association of Northern California (SEAONC) Building Ratings Committee (BRC), a sub-committee of SEAONC's Existing Buildings Committee (EBC), to improve the practice of seismic evaluation and seismic risk communication. The BRC has developed this User's Guide to explain the EPRS and to assist users in producing a rating.

In 2006, responding to a request from the Structural Engineers Association of Northern California (SEAONC) Board of Directors, the SEAONC Existing Buildings Committee agreed to form a subcommittee to study the feasibility of, and possibly to develop, an Earthquake Performance Rating System (EPRS). The subcommittee would later become known as the Building Ratings Committee (BRC).

The BRC completed its feasibility study in January 2008 and presented a paper summarizing the results at the 2008 SEAOC Convention (SEAONC EBC BRS, 2008). Further progress was presented at a 2009 conference sponsored by the Applied Technology Council and ASCE's Structural Engineering Institute and at the 2011 and 2012 SEAOC Conventions (SEAONC EBC BRS, 2009; 2011; 2012). In March 2011, the BRC collaborated with ATC to hold a workshop for building owners, investors, and policy-makers regarding the utility of an EPRS with the goal of hearing from potential users about the scope and structure of a marketable rating system.

The objective of the EPRS – and of any system that rates the earthquake performance of buildings – is to communicate earthquake risk not only to non-engineers, but specifically to "non-expert" stakeholders who might not even be experts in other aspects of building design, construction, or regulation. The ultimate goal is to reduce earthquake risk by providing stakeholders with practical information they generally have not had.

By "stakeholders," the BRC means not only the client who commissions an EPRS rating, but all those who have an interest in a building's earthquake risk – developers, buyers, sellers, and tenants of a building, as well as regulators, emergency managers, and policy makers. Thus, the audience for the system includes a broad and general population, much of which knows little about earthquake risk. The BRC expects users will find the EPRS particularly valuable for comparing buildings and for summarizing technical evaluation reports.

The EPRS is not itself a seismic evaluation methodology. The EPRS is primarily a set of definitions intended to improve existing engineering practices with respect to communicating earthquake risk to non-expert stakeholders.

As explained further in Section 2.1, the EPRS works by applying a rating to a separate seismic evaluation done with any formal or informal evaluation methodology. Since the EPRS is not itself an evaluation methodology, it does not replace any of the tools or methodologies engineers currently use to evaluate buildings. Instead, the EPRS repackages the findings of those tools and methodologies, translating them into consistent, comparable, jargon-free terms. In this way, the EPRS represents a SEAONC-recommended best practice for presenting the results of a seismic evaluation in a way that is concise, consistent, complete, and beneficial to a non-expert client.

"Non-expert" does not mean simply "non-engineer." Rather, the term is intended specifically to include non-engineer stakeholders who might never have worked with an engineer before. While the EPRS might prove useful to large institutions, corporations, and public agencies, most of those organizations already routinely engage engineers who can advise them directly, often taking advantage of state-of-the-art engineering tools. They generally do not need the simplification and summarization provided by an EPRS rating.

The BRC had in mind a number of cases of "non-expert" stakeholders who might benefit from the EPRS, including:

- Buyers or leasers of small buildings or tenant spaces, including residential properties, for which seismic evaluations are rarely available at the time of sale or lease. For these consumers, who might not have even considered earthquake risk otherwise, a rating to help compare one property to another in broad terms is perhaps more useful than a detailed evaluation relative to a specific performance objective.

- Institutions or organizations that already engage engineers to perform seismic evaluations of multiple buildings or portfolios, but need a means to classify or compare those evaluations and to present the summarized evaluation results to decision-makers or other stakeholders. For these organizations, the EPRS provides a consistent basis for grouping diverse buildings in pragmatic ways (a basis, the BRC feels, that is preferable to classification systems used in the past by various public agencies).

- Stakeholders who already rely on simplified presentations of seismic evaluation findings, such as estimates of Probable Maximum Loss, but who might not be well-served by the current state of practice. For this subset of potential EPRS users, quality control (of both the rating and the underlying evaluation) might be as important as the technical details of the rating system (ATC, 2011).

1.1. Qualified raters

The EPRS, like any building assessment tool, should be applied by qualified individuals. The BRC developed the EPRS with the expectation that it would be applied primarily by licensed civil or structural engineers experienced in building evaluation or design. However, the enforcement of qualifications is left to others. It is expected that clients or other stakeholders might develop and implement specific qualification measures to suit their own purposes.

The BRC expects the EPRS to be useful in any area with moderate to high seismicity. Even so, the BRC developed the EPRS with California practice in mind.

The BRC recommends the rating engineer have a PE or SE license. Although certain new buildings may be lawfully designed by architects or contractors, seismic evaluation of potentially obsolete or inadequate conditions requires different expertise. In addition, the rating engineer should be qualified to design the building being rated. For example, since an SE license is required to design California schools and hospitals, the BRC recommends the same qualifications for evaluating and rating those buildings. Though there are no regulations explicitly stating licensure requirements for rating engineers, the California Code of Regulations Title 16, Division 5, Section 415, does state that a licensed professional engineer may practice engineering "only in the field or fields in which he/she is by education and/or experience fully competent and proficient." A requirement for higher credentials is left to the discretion of the client or other stakeholders.

The EPRS rating engineer is also responsible for the underlying evaluation. Programs to produce ratings for past evaluations might need programmatic accommodations for those cases where the rating engineer is different from the engineer who performed the underlying evaluation.

1.2. Engineering judgment

All engineering, including seismic evaluation, involves judgment. When deriving an EPRS Rating, appropriate engineering judgment should be applied during the application of the underlying evaluation methodology (see Section 2.1), not during the translation of evaluation findings into a rating. Engineering judgment should only be applied by the engineer who performs the underlying evaluation. Where applied, judgment should be identified clearly in the supporting documents (see Section 3.2).

The intent of this provision is to respect the role of judgment in engineering and to guide its use to ensure generally consistent ratings by different engineers. Excessive or faulty judgment is a matter for quality control (see Section 1.3), but its existence does not change the fact that judgment is part of engineering.

The second sentence, about applying judgment during the evaluation but not during the rating, applies mostly to evaluation methods for which a detailed translation procedure is used. The intent is that if the translation results in a questionable rating, the engineer should not simply adjust the rating "by judgment," but should review the evaluation to find why it led to such a rating. It is more appropriate to apply judgment to the detailed evaluation process than to the simplifying rating process.

1.3. Quality control

In general, each engineer is responsible for the quality of his or her EPRS Rating, just as he or she would be responsible for the quality of the underlying seismic evaluation. It is expected that clients or other stakeholders might develop and implement specific quality control measures to suit their own purposes.

Quality control of the rating should follow the quality control provisions that apply to the underlying evaluation. Additional quality control measures will depend on the rating program established by the clients or stakeholders. These measures can be incentivized, institutionally imposed, one-sided, or mandatory.

2. The Rating System: Essential Features of the EPRS

2.1. Underlying evaluation methodologies

> Because the EPRS is not itself a seismic evaluation methodology, it does not replace any methodologies currently used to evaluate buildings. Rather, the EPRS is intended as a means to supplement a separate, or underlying, evaluation with a rating that summarizes and simplifies the evaluation findings in consistent EPRS terms.
>
> It is the intent of the BRC that separate documents, or guides, will be produced to translate the results of underlying evaluations into EPRS terms. At present, the BRC has developed a complete procedure (SEAONC EBC BRC, 2015) for the national standard known as ASCE 31-03 (ASCE, 2003).
>
> It is not the intent of the BRC to prohibit the use of any evaluation methodology, including informal, simplified, or judgment-based methodologies. However, it is the intent that EPRS Ratings would be derived using consensus procedures specific to each underlying methodology.

The underlying evaluation comes before the EPRS rating and generally contains more detail than the rating by itself. Therefore, it is the intent of the BRC to allow the engineer, the client, and other stakeholders the same discretion in choosing an evaluation methodology that they would have even if a rating were not being produced.

However, the selected evaluation methodology can affect or limit the EPRS rating. The BRC expects that some methodologies might not support or justify the full range of EPRS ratings. In general, the more engineering effort involved in the evaluation, the more likely it is that the full range of EPRS ratings might apply. By the same token, an extremely thorough evaluation might be able to make distinctions in performance that the simplified ratings cannot make.

Currently, the BRC has produced a translation procedure for one evaluation methodology, ASCE 31-03. (See Section 2.5 for further discussion of translation procedures.) Other methodologies that the BRC expects to see translated in the future include:

- ASCE 41-13
- FEMA P-58
- FEMA 154
- Procedures used to generate Probable Maximum Loss estimates
- Building Code provisions for new construction
- California Seismic Safety Commission checklists
- Low-cost methodologies based on drawing review and site observations.

2.2. Seismic hazard

> EPRS Ratings are intended to correspond to expected performance given a single earthquake with ground shaking between 75 and 100 percent of that used for the design of a new building of normal occupancy (Risk Category II) and of similar size and location.

The performance descriptions given in Section 2.4 are meaningful only when they are associated with a presumed earthquake hazard level (or ground shaking intensity). That is, for a building labeled "safe," the question remains: "Safe in what earthquake?" Section 2.2 addresses this issue in a way that the BRC feels balances the interests of rating engineers (EPRS rating producers) with those of the non-expert clients and stakeholders for whose benefit the EPRS is intended (EPRS rating consumers). In selecting the hazard described in Section 2.2, the BRC dealt with four questions:

<u>Should an EPRS rating reflect a more extreme condition or a more routine condition?</u>
Both extreme and frequent events, as well as events in between, are commonly used in seismic risk assessment. In engineering terms, the question can be restated as: Should an EPRS rating be associated with an extreme event like the Maximum Credible Earthquake used in current building codes; or with a routine event more familiar (and perhaps more relevant) to typical stakeholders, such as shaking with 50 percent probability of exceedance in a 50-year building life (73-year return period); or with a traditional “design basis” event, such as shaking with a 10 percent probability of exceedance over 50 years (475-year return period)?

The BRC decided that a seismic hazard between the routine and the extreme would be most appropriate for a rating intended to make distinctions among the wide range of typical buildings. With an extreme event, nearly all existing buildings would be rated poorly, and only the best would be distinguished. With a routine event, nearly all buildings would appear equally satisfactory, and only the very worst would be distinguished.

<u>Should the “in between” seismic hazard try to match standards used for new buildings, existing buildings, or something else?</u>
The BRC recognizes the advantages inherent in selecting a seismic hazard with some precedent in current codes, standards, and programs. One advantage is that it can facilitate communication to say that the EPRS seismic hazard is the same as a hazard already familiar to stakeholders. Also, if the hazard associated with an EPRS rating matches that used by the underlying evaluation, then the translation from evaluation to rating will not have to adjust for differences in presumed hazard.

Between routine and extreme hazards, several such precedents exist. Many engineers (incorrectly) think of 2/3*MCE, as used in current building codes, as a “design basis” seismic demand, in part because it is close in value to its probabilistic code precursor, a hazard with 10 percent probability of exceedance in 50 years (475-year return period). Either of these thus has strong precedents. The same may be said, however, for values long used for evaluation of existing buildings, such as 75 percent of forces used for design of new buildings, known as “reduced” forces in the IEBC model code. A similar option is that used in California Building Code provisions for state-owned buildings: a hazard with 20 percent probability of exceedance over 50 years (225-year return period), now defined in the ASCE 41-13 national standard as the BSE-1E hazard level. Similarly, the financial industry often considers risks with a 0.5 percent annual probability of exceedance (190-year return period). Any of these may be reasonably considered an “in between” hazard, neither extreme nor routine.

Since none of these is more technically correct than the others, the BRC decided it would be most advantageous to reference the values used in current building codes for new construction (2/3*MCE, also known in ASCE 41-13 as BSE-1N) and standards for existing buildings (BSE-1E). The goal is to accommodate the most commonly used “in between” underlying evaluation methodologies. ASCE 41-13, for example, allows the use of its Tier 1 checklist procedure only with a hazard level like BSE-1E, not BSE-1N. (ASCE 31-03 also intended that its checklists should be used with a reduced hazard, but it approached the problem in a different way. It used the same hazard as the code for new construction, but it built a 75 percent factor into its acceptance criteria.)

Where the BSE-1N and BSE-1E values are reasonably close to each other, the BRC concluded that the nature of the EPRS ratings as simplifications based on pragmatic distinctions can accommodate some variation in the seismic hazard used for evaluation. Because the EPRS ratings make distinctions using broad categories of performance, different ratings should result more from differences in expected damage modes (for example, falling hazard v. collapse, or nonstructural damage v. structural) than from small numerical differences in demand-capacity ratios.

Where the BSE-1N and BSE-1E values are not close to each other, then the goal of accommodating both hazard levels presents a problem. Table A1 shows the BSE-1N and BSE-1E values at the centers of four California cities. The rightmost column shows that in some locations, BSE-1E spectral accelerations are within 30 percent or so of BSE-1N values. But for many locations, the two values differ significantly – enough that even for EPRS purposes they no longer represent similar evaluation criteria. The BRC therefore decided to define the EPRS seismic hazard to encompass both BSE-1N and BSE-1E as "design basis" hazard levels, as long as the BSE-1E values are within the traditional 75 percent of BSE-1N. (For related reasons, the ASCE 41 committee is currently considering a similar floor on BSE-1E.)

Thus, the text of Section 2.2 cites the hazard level used for design of new buildings (BSE-1N) and accommodates evaluation methodologies that use reduced forces down to 75 percent of that benchmark.

Section 2.2 could as easily have referred to ground shaking up to 1.33 times that used traditionally to evaluate existing buildings. But since the evaluation standards have more recently changed, it was decided, for convenience and textual clarity, to link the EPRS seismic hazard to the building code design level. Doing so does not presume, however, that stakeholders will have an understanding of what that code design basis is. On the contrary, many non-experts tend to ask about potential building performance on a scenario basis, or in terms of Richter magnitude. The description in Section 2.2 thus at least provides the rating engineer with an opportunity to explain that seismic evaluations, and EPRS ratings, are based on site-specific hazards, not scenarios or past events.

One potential criticism of allowing the "75 to 100 percent" range is that it appears to be holding new buildings and existing buildings to the same standard, even while allowing existing buildings to be evaluated with reduced loads. New buildings are better, the argument goes, so they should receive higher ratings. The rebuttal to this argument flows, again, from the recognition that an EPRS rating is a simplification with broad categories, and its purpose is not to make fine distinctions. Within a rating level, some buildings will be nearer the top and some nearer the bottom, but that is the nature of a rating system with a small number of bins. The question is how to define the boundaries of those bins; the EPRS defines boundaries in terms of large pragmatic differences in expected modes of behavior, not based on the detailed numerical calculations performed as part of some underlying evaluation methodologies. Further, the rating levels defined in Section 2.4 make no mention of a building's age or code compliance; the EPRS also does not include importance factors, planning and zoning limits, or other requirements imposed on new buildings. Thus, the criteria used to rate a building with the EPRS need not match the criteria required by law for its initial design; in short, the building code and the EPRS have different goals. If a new building could receive a higher EPRS rating by using reduced seismic loads consistent with the seismic hazard described in Section 2.2, instead of code-mandated design loads, the rating engineer is free to take that approach.

City Lat,Lon	Freq	ASCE 41-13 http://earthquake.usgs.gov/designmaps/us/application.php Site Class B BSE-2N	BSE-1N	BSE-1E	Site Class D BSE-2N	BSE-1N	BSE-1E	Ratio of 1E to 1N SCB	SCD
Sacramento 38.58157, -121.49440	PGA	0.270	0.180	0.108	0.340	0.227	0.172	60%	76%
	5 Hz	0.675	0.450	0.271	0.851	0.567	0.429	60%	76%
	1 Hz	0.294	0.196	0.123	0.532	0.355	0.284	63%	80%
San Francisco 37.77928, -122.41927	PGA	0.600	0.400	0.345	0.600	0.400	0.398	86%	100%
	5 Hz	1.500	1.000	0.862	1.500	1.000	0.996	86%	100%
	1 Hz	0.629	0.419	0.327	0.944	0.629	0.571	78%	91%
San Diego 32.71742, -117.16277	PGA	0.488	0.326	0.126	0.494	0.329	0.195	39%	59%
	5 Hz	1.221	0.814	0.314	1.235	0.823	0.487	39%	59%
	1 Hz	0.470	0.313	0.134	0.719	0.479	0.304	43%	63%
Los Angeles 34.05368, -118.24270	PGA	0.979	0.653	0.342	0.979	0.653	0.396	52%	61%
	5 Hz	2.447	1.631	0.856	2.447	1.631	0.991	52%	61%
	1 Hz	0.858	0.572	0.305	1.287	0.858	0.546	53%	64%

Table A1. Spectral acceleration values for BSE-2N, BSE-1N, and BSE-1E hazard levels

Should the EPRS require underlying evaluations to use a specific hazard definition?

This question is related to the previous one, and the basic answer follows from that discussion: If the EPRS seismic hazard already accommodates a range of values, surely it would also accommodate a range of hazard definitions. But one might argue that the seismic hazard would be better if it were consistently probabilistic, or entirely code-consistent, or explicitly the same as the BSE-1E and BSE-1N hazards defined in ASCE 41-13.

The BRC decided that within the range of hazards described in Section 2.2, it is not necessary to require evaluations be done with specific defined hazards. Instead, the BRC decided that it is better to respect the engineer's and the client's discretion in selecting an appropriate evaluation methodology. Thus, an underlying evaluation may use the BSE-1E, or the code's 2/3*MCE, or the 475-year return period favored by loss estimation standards, or a suite of ground motions, or any other hazard within the range contemplated by Section 2.2.

Should the EPRS reflect a multi-point performance objective?

The concern here is that two buildings might perform about the same in a "design basis" event but much differently in a larger event like an MCE. ASCE 41 addressed this concern by defining a two-point performance objective involving evaluation or retrofit design calculations at two different hazard levels. The two-point objective (called the BSO in ASCE 41-06 and the BPOE or BPON in ASCE 41-13) has been adopted by some codes and institutional policies, including the federal recommended practice known as RP 8.

The BRC decided, however, that a multi-point objective is not necessary for the EPRS, and could be detrimental, for three reasons. First, it would over-complicate the rating, which is already more complicated than traditional risk presentations by virtue of its three dimensions. Understanding that a rating is a simplification that necessarily omits certain distinctions between buildings, the BRC finds that an EPRS rating will do its job best by communicating the expected performance for the type of event described in Section 2.2 only. One might argue that the EPRS would lose credibility if two buildings with the same rating perform differently in an extreme event. But the fact that the rating explicitly does not address extreme events covers that possibility; clients or stakeholders who also need to consider the extreme event may of course do so with their underlying evaluation. Also, if two similarly rated buildings performing differently in an extreme event creates a credibility problem, it is little different from two differently-rated buildings performing the same in a small or routine event. An inability to cover every contingency is the price of the simplification that an EPRS rating provides.

Second, requiring the evaluation to consider more of the hazard curve could create logistical problems that would reduce the accessibility of the EPRS to the clients and stakeholders for which it is intended. Additional rules and provisions would have to be developed to identify those cases where a two-part objective is necessary: Would those rules distinguish only collapse-prone structures, or also geologic hazards that might be worse in an extreme event, or financial losses? Whatever the answers, the rules would inevitably raise the cost of obtaining an EPRS rating. Just as important, requiring a multi-part evaluation would rule out the use of many existing evaluation methods that presume only a single hazard.

Third, it is not even clear that a multi-part evaluation is needed by clients or stakeholders. Engineers would like their clients to understand that extreme events are possible, and some organizations, such as city or county emergency planners, might need to be thinking about those cases. But that does not mean they need the simplified EPRS ratings to cover that ground. On the contrary, many private building owners and tenants are actually more concerned about the smaller, more likely event. To address their concerns, one could argue that a rating should supplement the design-basis hazard not with an extreme hazard but with a routine one. The BRC decided to limit the EPRS scope to the "in between" hazard described in Section 2.2.

Having considered these questions, the BRC settled on the language in Section 2.2. While this hazard is intended to accommodate some variation in engineering practice, the implication is that any evaluation done with a hazard outside the stipulated range will need to account for that difference during the translation from underlying evaluation to EPRS rating.

Section 2.2 also refers to "normal occupancy," what the building code refers to as Risk Category II. This means that EPRS ratings are given independent of a building's actual use or occupancy as understood by the building code. A hospital or fire station, for example, would be assigned to Risk Category IV and would be subject to higher design forces involving an "importance factor." The EPRS would rate these buildings just like any other building; their greater importance would be reflected in a policy choice to require a better rating. This is essentially the same approach taken by performance-based evaluation and retrofit standards such as ASCE 41-13.

In the end, Section 2.2 clarifies that it is necessary to describe the seismic hazard to which the EPRS applies, while it is still possible to accommodate variations without having to say that some evaluation methodologies are "correct" or appropriate while others are not.

2.3. Rating scope

EPRS Ratings do consider the performance of:

- Structural components
- Nonstructural components
- Fixed equipment specifically identified by the rating engineer
- Non-building structures associated with and immediately adjacent to the building
- Adjacent buildings (as falling and pounding hazards only)
- Geologic conditions within the building lot.

EPRS Ratings do not consider the performance of:

- Utilities or infrastructure outside the building footprint
- Most building contents routinely supplied or removed when tenants change
- Geologic conditions outside the building lot
- Externalities that commonly affect repair costs or recovery times

Variations from the basic scope should be identified clearly in the supporting documents (see Section 3.2).

The purpose of Section 2.3 is to make clear which parts of the property are considered by, and thus are able to affect, the EPRS rating. For purposes of communicating risk to clients or other stakeholders, the two lists can be used to call attention to aspects of potential damage that either are or are not addressed by the rating process.

The rating scope will not always match the scope of the underlying evaluation. Where the underlying evaluation considers issues beyond those covered in Section 2.3, those issues may be ignored by the EPRS rating. Where the underlying evaluation does not consider one or more items within the EPRS scope, the rating engineer will need to consider those in some fashion in order to provide the EPRS rating. Translation procedures are expected to provide prompts or specific instructions to ensure consideration of the full EPRS scope.

"Fixed equipment specifically identified by the rating engineer" is intended to provide an opportunity for the rating engineer to address certain nonstructural components, often tenant-provided and installed, that are often excluded from typical evaluation methodologies but might nevertheless have significant impact on Repair Cost and Recovery, if not on Safety. Examples might include function-critical equipment like manufacturing equipment or rooftop communications equipment. For items like these, the actual scope can only be described in concept; confirming the actual scope for any building is the responsibility of the rating engineer.

"Non-building structures associated with and immediately adjacent to the building" is intended to include structurally separate elements that are nevertheless clearly part of the facility, as opposed to a neighboring building. Examples include retaining walls, covered walkways, carports, or pedestrian bridges.

"Externalities that commonly affect repair costs and recovery times" refers to conditions outside the building owners' and tenants' control, such as the availability of utility services or roads, the overall safety and recovery of the neighborhood, etc. If externalities like these were considered by the EPRS, they could greatly affect the Recovery dimension of an EPRS rating (and to a lesser extent the Repair

Cost rating as well). In fact, the effects of externalities on recovery times can often be far greater than the effects of direct damage sustained by the building being rated. One might therefore argue that by excluding externalities from the scope, the EPRS is overlooking a critical aspect of post-earthquake recovery and might even be giving clients and other stakeholders a false impression of expected performance.

Nevertheless, the BRC decided that as long as the scope of the EPRS is clear to users (which is why externalities are explicitly noted in the heading of the Recovery section of Table 2.4), it would still be beneficial for ratings to provide some information about how the building's own deficiencies might affect recovery. Otherwise, any evaluation or rating of expected recovery time would require work well outside the scope of normal seismic evaluations. Without that additional costly work, No Rating would be the only defensible choice for the Recovery rating. As recovery time becomes better defined and more commonly assessed, it will be important to evaluate and design for externality effects. At present, as recovery evaluation is new and still rare, the BRC decided to at least use the EPRS as a way of raising the issue to clients and stakeholders. Where the rating engineer feels that a Recovery rating excluding externalities would not properly serve his or her client, No Rating remains a useful option. (For more on how to account for externalities, see Almufti and Willford, 2013.)

Related to externalities are conditions that delay initiation of post-earthquake repairs, such as post-earthquake inspections, access to financing, engineering review or re-design, contractor mobilization and permitting, long lead-time items, etc. Almufti and Willford (2013) refer to these as impeding factors. Mostly these factors are expected to affect recovery time. The EPRS does not address them explicitly. Given the indefinite EPRS rating levels for Recovery, the BRC expects that where damage is low enough to merit one of the better Recovery ratings, delays due to impeding factors will be small anyway. Where the damage would lead to a worse Recovery rating, delays due to impeding factors will already be within the uncertainty of the rating definition. Thus, while these impeding factors are probably addressed implicitly by the EPRS, they are not explicitly listed as within the current EPRS scope.

2.4. Rating definitions

Table 2.4 gives the definitions of EPRS Rating levels for each of three rating dimensions: Safety, Repair Cost, and Recovery. Each level has a symbolic representation (one to five stars), a short name or label meant to convey the basic meaning of each distinct level, and a longer description intended to explain the short label in terms closer to those used by engineers and by underlying evaluation methodologies.

EPRS ratings are intended to correspond to expected performance given the seismic hazard described in Section 2.2.

Table 2.4. EPRS Rating Levels defined for each of three rating dimensions

The symbolic stars and the short labels for each rating level are intended to make it easier for non-experts to discuss the expected performance without becoming mired in engineering jargon. Nevertheless, the BRC understands that engineers (or their clients or other stakeholders) might be uncomfortable with the short labels being used out of context or without the longer description that follows. The BRC therefore expects that some engineers might choose to convey ratings without the short labels. It is the BRC's intent, however, that the longer descriptions should not be altered or omitted when conveying EPRS ratings.

Section 2.4 notes that the longer descriptions are "closer to" the terms used by engineers and by underlying evaluation methodologies. Even so, the EPRS terminology is not identical to language found in any code or standard because even these long descriptions are intended to be adaptable to a variety of methodologies.

The construction of the long descriptions is important and intentional. Each begins with "Expected performance would …," a construction intended to reflect the fact that assigning a rating is a two-step process. The first step is to determine the expected performance of the building. The second step is to extrapolate or translate that performance into terms of safety, repair cost, or recovery time.

Only the first step is something engineers are generally trained to do. The second step is something that an evaluation methodology might do, but does not involve structural analysis. Evaluation methodologies that take this second step and quantify losses (in addition to predicting structural response) might be able to offer a more specific numerical performance prediction than the EPRS rating definitions, but many evaluation methodologies do not do this directly. It is for this reason that the rating definitions use phrasing such as "commonly associated with …" instead of phrasing that suggests a calculated answer, such as "likely to result in …". Without fragility curves that relate injuries, costs, and downtime to each predictable pattern of structural or nonstructural damage, the BRC decided that the wording of the rating definitions should not imply (or make the rating engineer responsible for) such a calculation.

The term "expected" sometimes denotes a probability greater than 50 percent. In the rating definitions, however, "expected performance" is not meant to imply any specific probability of occurrence or exceedance. Rather, it is meant to reflect whatever conclusion the underlying evaluation methodology, together with the evaluating engineer's judgment, would reach. In some cases this will be qualitative (a component is braced or is not) and in others it will be quantitative (a demand-capacity ratio is less than 1.0 or it is not). In any case, it is not the intent of the BRC to impose a probabilistic meaning where the underlying evaluation did not provide one.

While the term "expected" is not included in the short labels, it is nevertheless implicit in them, as the short labels should be understood only as convenient placeholders for the longer descriptions.

1. <u>Three separate dimensions</u>

Currently, the three dimensions, or components, of an EPRS Rating are Safety, Repair Cost, and Recovery.

- The Safety Rating addresses the physical health and safety of building occupants during the earthquake shaking and through egress.

The Safety Rating does not directly address the needs of disabled, differently abled, or especially vulnerable occupants such as children, the elderly, or the ill. Considerations for special occupant groups should be reflected either by judgment in the underlying evaluation or through the policy that sets a target or acceptable rating.

- The Repair Cost Rating addresses the financial loss associated with repairs needed to restore the pre-earthquake condition.

The Repair Cost rating is different from simple loss, as it tries to account for actual expense to make repairs, not the paper loss of equity. The repair cost is intended to reflect the full repair cost, not the insured cost. It is not intended to include the cost of triggered upgrades or voluntary improvements. Because repair cost is expressed in terms of replacement cost, it does not include premiums for historic, archaic, unique, or otherwise irreplaceable construction.

- The Recovery Rating addresses the time needed to restore the building's capacity to support the basic intended functions of its pre-earthquake use and occupancy. Thus, Recovery here means "functional recovery," as opposed to reoccupancy or full recovery.

In general, functional recovery means the owners' and tenants' ability to resume normal pre-earthquake operations, which can vary with occupancy. However, because the EPRS cannot consider most contents, functional recovery is essentially limited to the capacity of the *building* – the structure and its permanent nonstructural components – to support those functions. Functional recovery does not require the repair of cosmetic damage and does not require full use of all of a building's non-essential functions.

Functional recovery generally requires legal occupancy, which might involve appropriate egress, fire safety, etc., but the EPRS does not explicitly account for these issues. Rather, the EPRS effectively assumes that some or all of these requirements might be waived during an emergency period or might be provided on an interim basis by temporary or programmatic means. Because the EPRS does not account for externalities such as utility outages, the Recovery rating effectively assumes that utility service will be restored by the time recovery-critical building damage is repaired. (See Section 2.3 for discussion of externalities and the EPRS scope.)

Functional recovery is contrasted with reoccupancy, at which time the building may be safely occupied, a state often represented by an ATC 20 "green tag" and sometimes by the term "shelter-in-place." By contrast, functional recovery means a usable space, not merely a safe-to-occupy space. Functional recovery is also contrasted with full recovery, at which time even cosmetic damage is repaired and even non-essential functions are restored. (Bonowitz, 2011.)

The three dimensions are conceptually independent, so a 3-star Safety Rating, for example, does not imply and is not implied by a 3-star Repair Cost Rating or a 3-star Recovery Rating.

Section 2.4 intentionally shows the three dimensions in separate tables to reinforce the idea that they are independent in concept and presentation. The three dimensions are not fully independent, however, because all are derived from the same expected or predicted damage patterns. The dimensions might be less independent for some methodologies than for others, since most methodologies explicitly address only one or two of the performance dimensions. In such cases, a translation procedure might use the results of a safety evaluation, for example, to roughly predict repair cost or recovery time.

The BRC encourages presentation of all three dimensions even if No Rating is given for one or two of them, as this communicates to clients and other stakeholders that earthquake performance is increasingly about more than safety or economic loss.

The BRC encourages ratings that are clear on all three dimensions (see also Chapter 3). The intent is to avoid the situation where a client interested in economic loss or minimal business disruption nevertheless receives only safety-related information because he or she did not know to ask for a more complete scope of work from the evaluating engineer. The three-part rating is intended to have the effect of anticipating the broader question even when it is not explicitly asked.

2. Five levels within each dimension
The five rating levels are expected to capture practically all of the current building stock. However, it is neither the intent nor the expectation that the five rating levels represent equal portions of the building population. Rather, the BRC expects the highest rating levels to be assigned only rarely and only where the building's design explicitly sought exceptional performance relative to a typical new building of normal occupancy.

The BRC attempted to develop rating scales that would capture a wide range of performance without giving an undue impression of precision. Usability and appropriate simplicity were also considerations, with the understanding that a three-part EPRS rating would already be more complex than most single-scale ratings. A five-level scale was thought to be sufficient.

Though buildings rated at the highest levels will be rare, the BRC included these levels to be aspirational, to convey that better performance is possible. Still, even the highest rating levels might not distinguish those buildings designed for truly exceptional performance. By the same token, even the lowest rating levels do not distinguish the very "worst of the worst," such as collapse-risk buildings that would merit 1-star ratings in even a small earthquake.

3. A "No Rating" option
In addition to the five rating levels, each dimension has a "No Rating" option for cases where the underlying methodology does not justify or support a specific rating. The No Rating option may also be used where a rating for that dimension is not required for the rating program. (See Section 2.6: Specialized ratings.)

Where an underlying methodology does not explicitly address one or more rating dimensions, the ratings derived from the evaluation results are likely to be quite conservative. In these cases, No Rating can be an appropriate option, as it might be preferable (to the rating engineer or to the client) to convey uncertainty rather than over-conservatism.

In other cases, the underlying methodology might not justify a rating at all for one or more dimensions. In these cases, No Rating serves as an appropriate placeholder to remind the user that this dimension of performance is meaningful but has not been investigated.

No Rating is also useful where one or more dimensions is not requested by the client or the rating program. For example, a program that focuses only on safety and reoccupancy might not care about Repair Cost and might not be well served by a Recovery Rating based on functional recovery. In these cases, a rating of No Evaluation might be even more appropriate than No Rating, but the BRC does not yet consider it necessary to add a seventh such option to rating definitions.

4. Pragmatic distinctions between levels

Where industry and regulatory precedents exist, the rating levels are set to respect them. Otherwise, the rating levels are intended to respect the perspective of rating users (owners, tenants, lenders, regulators), as opposed to more academic or theoretical perspectives of some engineers and researchers.

"Pragmatic distinctions" means that rating levels are separated by boundaries that have practical meaning to clients or stakeholders. It is the BRC's intent that, where possible, different ratings should represent broadly different limit states or modes of performance, as opposed to arbitrarily higher or lower degrees of deficiency, or likelihood, within a single mode. For this reason, the EPRS ratings are not based on scores or points, the star symbols are non-numeric (so that there is no such thing as half a star), and the short rating labels avoid adjectives such as Good, Fair, High, Low, Severe, or Minimal.

The Repair Cost ratings offer good examples of distinctions with industry precedent. The 20 percent and 40 percent SEL values cited in the descriptions are linked to established precedents in lending and insurance.

Similar industry and regulatory precedents do not exist for Safety and Recovery. If, however, a standard practice were to arise making a key distinction based on, for example, percentage of occupant casualties, then the BRC would consider adjusting the Safety levels to match that precedent. Similarly, if a precedent were to arise making a key distinction based on, for example, ability to recover function by 72 hours or 30 days, then the BRC would consider adjusting the Recovery levels to match that precedent.

Since the Safety Rating levels do not have industry precedents to follow, the defined levels reflect the interests of typical non-expert owners and tenants who routinely ask: Could this building kill someone? Hence the main distinction between the 2-star and 3-star Safety Ratings. Below that line, the Safety levels reflect distinctions between local and global collapse. Above it, they represent distinctions thought by the BRC to be significant to owners, tenants, and emergency responders. More specifically:

- Buildings with any of the following deficiencies will generally be assigned a 1-star Safety Rating:
  - Substantial overstress or inadequate detailing of primary elements of the seismic force-resisting system.
  - Missing or substantially inadequate fundamental load path components.
  - Global collapse-prone irregularities.
  - Slope failure or surface rupture.
  - Fire- or explosion-prone nonstructural deficiencies.
- Buildings with any of the following deficiencies will generally be assigned a 2-star Safety Rating:
  - Local collapse-prone deficiencies
  - Liquefaction
  - Heavy overhead falling hazards
- Buildings whose only deficiencies involve non-life threatening nonstructural falling hazards will generally be assigned a 3-star Safety Rating.
- Buildings with no deficiencies meriting a 3-star or worse rating will generally be assigned a 4-star Safety Rating.
- Some buildings with stiff lateral systems and buildings detailed specifically to avoid egress-inhibiting damage (such as base isolated buildings) are eligible for a 5-star Safety rating.

The Recovery Rating levels are obviously vague, reflecting both the difficulty of predicting downtime and the lack of tested evaluation methodologies to support such predictions. A few evaluation methodologies are beginning to use more precise terms, but until they are vetted and widely used, and keeping in mind that the EPRS ignores most externalities, the BRC believes that the current rating levels have appropriately soft edges, so that the judgment of the rating engineer may play a significant role. As noted above, No Rating is always an option. Even if No Rating is given, it is the intent of the BRC that a space for the Recovery Rating should nevertheless be presented to the client to indicate that downtime can be a significant loss and that recovery is an emerging issue in engineering and emergency management.

2.5. Translating the underlying evaluation

The heart of the rating process is the translation of underlying evaluation results into an EPRS Rating. A translation procedure should be suited to the underlying evaluation methodology. The more formal the evaluation methodology, the more detailed and specific the translation procedure will likely be. In all cases, however, an EPRS rating is a simplified summary of the evaluation findings, so it will almost always present less certainty and less detail than the underlying evaluation. Translation of evaluation findings to EPRS Ratings is therefore best thought of as the process of selecting not the perfect description of expected performance, but the best description from among five available choices.

A translation procedure is a set of rules and logical decision trees (perhaps involving flowcharts, worksheets, checklists, or other tools) to translate the results of an underlying evaluation into a three-part EPRS Rating. The BRC's translation of ASCE 31-03 is one such example (SEAONC EBC BRC, 2015). Each evaluation methodology will have its own translation procedure. The procedure takes as inputs the typical results of the evaluation methodology, which might be deficiency lists, demand-capacity ratios, "PML" values, etc., depending on the methodology.

Though it is the intent of the BRC that translations would ideally be done with consensus procedures, a formal translation procedure is not strictly necessary. In concept, any engineer could complete an evaluation of any sort and then characterize the results in EPRS terms, using the rating definitions from Table 2.4 together with his or her own judgment. This would help establish the EPRS as a common set of terms.

A detailed translation procedure for any formal, documented evaluation methodology will respect the eligibility limits, the required scope of work, and the performance assumptions and descriptions given by the methodology itself. Where the methodology is incomplete as to its performance definitions, the translation procedure will include the judgment of the BRC or other organizations that develop the procedure. In these cases the No Rating option may be the best choice.

As noted in Chapter 1, the EPRS is not itself an evaluation methodology. In particular, the BRC was careful not to create its own evaluation rules or criteria, but to respect those of the underlying evaluation methodology. Ideally, whether an underlying evaluation merits a 3-star Repair Cost Rating, for example, should be based primarily on whether the evaluation methodology itself makes an assertion that the SEL (perhaps modified to reflect repair cost as opposed to hypothetical loss) would be less than 20 percent of replacement value in the stipulated seismic hazard. In many cases, however, evaluation methodologies will not be that clear; in these cases, the translation procedure will represent the judgment of its authors.

Currently, the BRC has developed one complete translation procedure, for ASCE 31-03 (SEAONC EBC BRC, 2015). It is the BRC's intent that procedures for other evaluation methodologies will be developed and provided in future guides. Again, however, it is not the intent of the BRC to prohibit the use of any evaluation methodology, including informal, simplified, or judgment-based methodologies.

The BRC's translation procedure for ASCE 31-03 already incorporates some of the revisions made to the methodology as it was updated to ASCE 41-13. The ASCE 31 translation procedure already acknowledges that it can apply, with judgment, to ASCE 41-13.

The BRC anticipates that translations for new and robust evaluation methodologies, such as FEMA P-58, will be relatively straightforward and easy for others to produce. Where such methodologies are used, however, it is not clear that the client, having already commissioned a sophisticated evaluation, would still need the added summary or simplification of an EPRS Rating. Many more evaluations are currently performed using code-based procedures (either the code for new construction or specialized provisions such as IEBC Appendix A), simple checklists (such as the California Seismic Safety Commission's *Homeowner's Guide*), or even quick drawing reviews and walk-throughs. These evaluation methodologies might not justify high ratings, but the BRC encourages development of translation procedures to support such common practices.

The BRC started with ASCE 31-03 because it was, at the time, the national standard for seismic evaluation and because its checklist approach lends itself to a well-defined translation procedure. The expectation is that future translation procedures for other methodologies will, where necessary, use the ASCE 31-03 or ASCE 41-13 procedure as a benchmark.

Where other methodologies are incomplete, the translation procedure might determine that No Rating is justified, or that the methodology can justify only a conservative rating based on the judgment of the procedure's authors. For example, ASCE 31-03 is not explicit as to repair costs, so the BRC's translation procedure assigns Repair Cost ratings based on conservative judgments about the implications of certain safety-related evaluation results (as described further in SEAONC EBC BRS, 2012).

2.6. Specialized ratings

By addressing a broad range of potential earthquake performance in three quasi-independent dimensions, the EPRS is more comprehensive than most specialized evaluation methodologies and rating systems in use today. Nevertheless, the BRC recognizes that many rating programs will not need so detailed an approach. While a three-part rating is more complete and in many cases more clear, and while the BRC encourages engineers to use the EPRS as a recommended practice, specialized ratings might better serve the immediate needs of certain clients or other stakeholders. Specialized ratings might involve only some EPRS dimensions and levels and might give certain combinations of rating levels their own designations.

These specialized ratings can be derived from the more comprehensive EPRS. It is the position of the BRC that rather than replace the EPRS, specialized ratings should be built from it and linked back to it, so as to maintain the benefit of a common set of ideas and definitions.

An early insight, discussed in the BRC's published conference papers, is that a single rating *system* is probably not appropriate for every rating *program*. In particular, the BRC developed the relatively detailed EPRS with voluntary, private, stakeholder-generated ratings in mind. A mandatory, public program, perhaps overseen by a local building department, would almost certainly need a simpler set of ratings. Even so, because the EPRS is comprehensive (or nearly so), simpler systems can be built from its parts. With the EPRS as a common platform, these simpler, specialized rating systems will be mutually consistent and traceable to common terminology, so that the same term will have the same meaning in different systems and programs. The BRC expects this approach to serve multiple stakeholder groups without repeating (and perhaps even resolving) the inconsistencies inherent in the many guidelines and methodologies in use today.

Specialized ratings serve different stakeholder perspectives, not different building types or occupancies. There is no reason to think that the EPRS is appropriate only for existing buildings (as opposed to new) or only for commercial buildings (as opposed to 1-2 unit residential). But it is easy to see why an emergency planner interested in reoccupancy might want different information from a rating program than a renter interested in safety or a real estate investor interested in return on investment.

The PML (Probable Maximum Loss) market is an example of a specialized rating program. The lenders and insurers who rely on it expect basic safety (and thus do not need five nuanced Safety levels) but are focused primarily on financial losses. A specialized rating to serve their interests might consider some of the EPRS Safety levels, all of its Repair Cost levels, and none of its Recovery levels. The recovery-focused categories defined by SPUR (San Francisco Planning and Urban Research) are another specialized system that can be built from and linked to the EPRS (once a reoccupancy dimension is added). SPUR categories A – D ignore financial loss, distinguish "safe" from "unsafe" buildings in a binary fashion, and focus on the time to safe reoccupancy, from hours to years.

3. The Rating Presentation

An EPRS Rating should be communicated in a way that supports its goal of clear and effective communication to non-expert stakeholders. These guidelines for presenting an EPRS Rating to a client or user are important because the EPRS as a defined system is new, even if its concepts are familiar and pragmatic.

The BRC anticipates at least two levels of presentation, as outlined in the following sections.

Eventually, if the EPRS is successful, the BRC would expect to hear statements such as "This building got 4 stars for safety," or "This is a 4-3-3-star building." Such shorthand references exist for other *de facto* rating systems already. For example, people say that a building "satisfies Life Safety" without stating the hazard level and without clarifying whether nonstructural components have been considered. Similarly, people say a building "has a PML under 20" without clarifying whether that is an SEL or SUL value.
The BRC could add to the User's Guide a template for the summary presentation, but for now it leaves that to rating engineers and implementing bodies, who might want to use their own logos and formatting.

Regardless of presentation type, format, or content, the presentation should not refer to SEAONC in any way that might give the impression that SEAONC produced or reviewed the rating.

The BRC expects that a rating engineer might add a disclaimer or other explanatory or contractual language, and that such language might refer to SEAONC, the EPRS, or this User's Guide. This is acceptable, as long as the explanation in no way gives the impression that SEAONC produced, reviewed, or approved the rating actually being presented. While SEAONC makes the EPRS available for use by qualified engineers and by implementing organizations and agencies, it is SEAONC's position that the engineer whose seal and signature appear on the presentation is responsible for the rating, that SEAONC did not produce, review, or approve the rating, and that SEAONC assumes no responsibility for its use by any party.

3.1. Summary presentation

When delivering an EPRS rating to the client, the rating engineer should use the full presentation described in Section 3.2. The summary presentation is intended merely as an optional (but recommended) cover sheet, with the expectation that the client might post or forward just the summary, without all of the supporting documents that are part of a full presentation. The summary presentation is expected to fit on one side of a standard 8.5x11 sheet.

The BRC recommends that a summary presentation include all of the following:

- A building identifier. This can be the street address, the client's name for the building, or any designation that uniquely identifies the building being rated.
- The three-part rating, showing each rating dimension and the symbolic rating (the stars or "NR" for No Rating; see Table 2.4) for each dimension. It is important that each dimension – Safety, Repair Cost, Functional Recovery – be shown with its own rating, as opposed to showing a single rating for all three dimensions together.
- The rating engineer's seal, which should show the engineer's name and license number.
- The rating engineer's signature.
- The date of the signature and seal, which may be taken as the effective date of the rating.
- The full set of EPRS Rating definitions, from Table 2.4, including the symbol, the name, and the definition of each rating level for each rating dimension.
- The underlying methodology used to derive each dimension's rating.

All three rating dimensions should be shown even if one or more of them has No Rating. As discussed above, the idea of a multi-dimensional rating is essential to the EPRS because it more completely communicates the evaluation results to the client and other stakeholders. If a dimension has No Rating, even that information conveys to the user that certain potential losses have not been investigated, but are considered significant by experts. Further, the multi-dimensional focus preserves the EPRS as a comprehensive foundation for specialized ratings that might use only one or two dimensions or might combine ratings into special categories.

Ideally, the stars should be shown in a format that conveys "__ out of 5 possible." For a 3-star rating, for example, this might be done by showing three stars and leaving two blank spaces where additional stars might have gone.

Use of the engineer's seal should follow any prescribed requirements by the state or jurisdiction. California, for example, has separate licenses for Professional Engineers (which show their branch, e.g. Civil) and for Structural Engineers, as well as requirements for the content and size of the seal and how to sign and date its use.

In California, the definition of civil engineering in Business and Professions Code Sections 6701-6702 would seem to include seismic evaluation and, by extension, application of a rating system like the EPRS. Nevertheless, the state has not generally required an engineer's seal on reports or evaluations that are "not for construction." The BRC recommends that organizations or agencies implementing the EPRS should treat the rating process as if it were in fact the practice of engineering and to that effect might add regulatory language to any templates they produce to facilitate summary or full rating presentations.

In addition, the BRC recommends including the following statement (or something similar, at the rating engineer's discretion) for completeness (see also Sections 2.2 and 2.3):

> These ratings correspond to expected performance given a single earthquake with ground shaking between 75 and 100 percent of that used for the design of a new building of normal occupancy (Risk Category II) and of similar size and location. The rating does not address the performance of certain contents, utilities, infrastructure, or geologic conditions outside the building footprint or lot. See the EPRS User's Guide for a full description of the rating scope.

Refer to the commentary on Section 2.2 regarding the EPRS seismic hazard and Section 2.3 regarding the EPRS rating scope.

3.2. Full presentation

The full presentation represents the BRC's recommendation for the minimum amount of information that a rating engineer should deliver to the client.

The BRC recommends that a full presentation include all of the following:

- A summary presentation, or all of the information required for a summary presentation, as described in Section 3.1.
- Any summary or report form contractually required by the client or the organization or agency implementing the EPRS.
- The EPRS translation. This is a report showing how the EPRS Rating was derived from the underlying evaluation. Where a formal translation procedure exists, this report might take the form of that procedure, with any flowcharts or worksheets provided there.
- The underlying evaluation report. The format and content of the underlying evaluation report will

vary with each methodology. In general, the report must be sufficient to show how its results were produced and where the judgment of the evaluating engineer, if any, was applied (see Section 1.2). The BRC recommends including a summary of the underlying evaluation showing the results used as inputs to the EPRS translation procedure.

Often, a client will prefer to see evaluation results presented in a standard format. Presentation of the EPRS rating should not interfere with any such requirements. Where no such requirements are made, it is often useful, or good practice, to provide a summary of pertinent information about the structure, either at the top of the submittal package or as a summary of the underlying evaluation. Such a summary might include, at the engineer's and client's discretion:

- A list of the drawings and documents reviewed
- A description and documentation of any site visits performed
- Building design information, including the original design code and edition, a history of any structural alterations, and past and current use and occupancy
- Description of the seismic force-resisting system, the gravity force-resisting system, and the foundation
- Site seismicity parameters
- Key deficiencies identified by the evaluation.