DRAFT RECOMMENDATIONS EVALUATION FOR PUBLIC COMMENT
FATIGUE RISK MANAGEMENT SYSTEMS

SUMMARY:

In March, 2007, the CSB recommended that the American Petroleum Institute[1] (API) and the United Steelworkers International Union[2] (USW) jointly lead the development of an ANSI consensus standard with guidelines for fatigue prevention. The recommendation arose from the investigation of the BP Texas City refinery incident in 2005 (For additional information, see http://www.csb.gov/investigations/detail.aspx?SID=20&Type=2&pg=1&F_InvestigationId=20).

With this notice, the CSB is requesting public comment on the draft evaluation of the actions taken by the API and USW to implement the CSB recommendation. The evaluation offers the staff's critique of two documents that were prepared in response to the recommendation, as follows:

1) Recommended Practice ANSI/RPI 755, *Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries*, First Edition, April 2010, developed under the auspices of API serving as the ANSI secretariat or convener; and,
2) API Technical Report 755-1. *Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries, Scientific and Technical Guide to RP-755*, 2010. Prepared for the American Petroleum Institute by Circadian®.

To obtain copies of these documents, interested parties should contact the American Petroleum Institute via internet (www.api.org) by phone (1-800-854-7179 or 303-307-7956) or fax (303-397-2740.

Interested parties in the public and private sector are invited to comment publicly on:

- Any aspect of the draft CSB analysis summarized in this document;
- Whether RP 755 is consistent with the CSB recommendation that triggered it; and,
- Any other relevant aspects related to RP 755 and the management of fatigue risk in the refinery and petrochemical industries.

Written comments must be received by the CSB on or before April 12, 2013, at 5 p.m. EDT. Following the public comment period, a CSB public meeting to consider the issue will occur at 9:30 a.m. EDT on April 24, 2013, in Washington, DC. The meeting will be held at the Ronald Reagan Building and International Trade Center, Horizon Room, 1300 Pennsylvania Avenue N.W., Washington, DC 20004.

SUBMISSION AND PUBLIC AVAILABILITY OF COMMENTS:

[1] The American Petroleum Institute is a national trade association that reportedly represents nearly 400 members from all aspects of America's oil and natural gas industry, from very large to small and independent oil companies.
[2] The union has since merged to become The United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union. USW is used in this summary for the sake of brevity.

Electronic submission of comments is highly preferred. Comments should be submitted by e-mail to fatiguecomments@csb.gov. They may also be submitted by mail to Chemical Safety and Hazard Investigation Board, Office of Congressional, Public, and Board Affairs, Attn: D. Horowitz, 2175 K Street, NW, Suite 650, Washington, DC 20037.

Comments may be submitted in the body of the e-mail message or as an attached PDF, MS Word, or plain text ASCII file. Files must be virus-free and unencrypted. Include CSB–13–01 in the subject line of the message. Please ensure that the comments themselves, whether in the subject line, the body of the e-mail or in attached files, include the docket number (CSB–13–01), the agency name, and your full name and address.

All comments received, including any personal information provided, will be made available to the public without modifications or deletions. While the public comments submitted before and during the meeting will be carefully analyzed by CSB staff and the Board, the Board does not assume any obligation to respond to them individually, or during the public meeting. Comments received by the CSB will be posted online in the Open Government section of the CSB web site, http://www.csb.gov/open.aspx

SUPPLEMENTARY INFORMATION:

Background:

On March 23, 2005, the BP Texas City refinery experienced explosions and fires in an isomerization unit (ISOM) that resulted in 15 deaths, 180 injuries, and significant economic losses. A CSB investigation found that the incident was caused by multiple technical, system, and organizational deficiencies, and the agency issued recommendations to various parties. Among its most important findings, and the subject of this draft evaluation, the CSB investigation concluded that the ISOM operators were likely fatigued from working 12-hour shifts, some working as many as 29 consecutive days during the turnaround of the unit prior to startup, and that, as a result, the operators' judgment and problem-solving skills were likely degraded, hindering their ability to determine that the tower was overfilling with hydrocarbons and to take prompt corrective actions.

The CSB found that neither the Occupational Safety and Health Administration (OSHA) nor the API had developed any industry safety guidelines or voluntary standards to manage and prevent fatigue as a risk factor, and especially to limit hours and days of work and manage overtime and shift work so as to prevent fatigue.

The CSB recommended that API and the USW jointly lead the development of an ANSI consensus standard with guidelines for fatigue prevention, along with the participation of other relevant stakeholders. The recommendation also identified the need to include in the development of the standard a broad range of stakeholders and relevant scientific organizations and disciplines, clarifying that the expectations for consensus went beyond those of a typical ANSI process.

There were numerous equipment failures as well as other factors that contributed to the liquid overflow that led to the Texas City incident, but these were not the subject of this recommendation and are not addressed in the evaluation. Information about them can be found in the investigation report and on the CSB webpage (www.csb.gov).

The recommendation was as follows:

Recommendation No. 2005-04-I-TX-7

Work together to develop two new consensus American National Standards Institute (ANSI) standards. In the second standard, develop fatigue prevention guidelines for the refining and petrochemical industries that, at a minimum, limit hours and days of work and address shift work. In the development of each standard, ensure that the committees a. are accredited and conform to ANSI principles of openness, balance, due process, and consensus; b. include representation of diverse sectors such as industry, labor, government, public interest and environmental organizations and experts from relevant scientific organizations and disciplines.

Both recipients initially accepted the recommendation. The API, already an ANSI-accredited organization with experience in developing voluntary consensus standards, formed an ANSI committee that the USW joined. In August of 2009, however, the USW withdrew from the committee in protest of what it perceived to be an imbalance in voting members (management vs. union and other representatives). The API proceeded with the committee's work and issued an ANSI-approved Recommended Practice (RP 755) in April 2010. CSB staff participated in parts of numerous meetings in person or by conference call, and were able to review the documents relevant to the development of the RP.

Draft CSB Evaluation

Although RP 755 makes a contribution to chemical safety by explicitly stating that "workplace fatigue is a risk to safe operations" and also by suggesting various measures to manage fatigue risks, it falls short of what such a standard should expect of employers, and, specifically, it does not fully meet the intent of the CSB recommendation in multiple important respects, which are summarized below.

1. **The document was not the result of an effective consensus process, and therefore does not constitute a tool that multiple stakeholders in the industry can "own." It was not balanced in terms of stakeholder interests and perspectives, and did not sufficiently incorporate or take into account the input of experts from other industry sectors that have addressed fatigue risks.**

In the early stages of the committee, there were typically 1-3 USW representatives, approximately 15-20 representatives of the refinery, chemical, and construction industries or their associations, and fewer than five other voting members, one of them Circadian, the firm that API contracted to develop the technical guidance document for implementation of the RP. Organized labor, one of the two major stakeholders, withdrew in protest about midway during the effort because of what it perceived as an imbalance in the voting members of the committee.

The early preponderance of industry perspectives, later an almost exclusive presence, indicates a lack of balance on the committee. ANSI standard rules have typically sought to limit the voting members of any given "sector" to less than one third of a committee, to prevent dominance. To meet this standard, one would have to assume that each individual industry representative is a different "sector," an argument that is difficult to make in light of the subject matter of the RP, where the views of individual companies in the industry are likely to be extremely similar. In effect, a sizable voting majority of committee members was drawn from the refinery and petrochemical industries and their trade associations.

The CSB recommendation called for the direct participation by members of other sectors such as "government, public interest and environmental organizations," as well as substantive participation or input from "experts from relevant scientific organizations and disciplines." These did not occur or were extremely limited. There was very limited participation from scientific and regulatory experts from the transportation (aviation, rail, trucking) and nuclear industries, and only a very limited input from the UK's Health and Safety Executive. Yet these are the industry sectors and institutions with the most extensive experience in the issues which the committee was examining, and which have done specific work on the goal of the CSB recommendation (e.g., methods for the evaluation of adequate staffing and fatigue risk, limits on hours of service, overtime, shift work, and other fatigue risk factors). The content of the final RP strongly suggests that the experiences of other sectors did not play a significant role in the development or peer review of the RP, as they are not reflected or referenced in the final RP, and they are only mentioned in a very limited way in the accompanying Technical Report (TR). For example, the TR has only a few mentions of other fatigue regulatory limits, and neither the section of the RP addressing the issue of limits on hours of service, nor the discussions of this topic in the TR, provide any systematic analysis or comparison with limits recommended in the transportation or nuclear sectors in the U.S., or with those in the United Kingdom or elsewhere in Europe.

The API efforts to constitute the committee included open invitations in multiple media (e.g. ANSI Standards Action and *Federal Register*) as well as efforts to contact labor and other participants directly. Such efforts have typically been considered sufficient "openness" in voluntary consensus standard circles. The CSB recommendation called for a broader and more balanced participation, however, and subsequent communications from staff to the committee reiterated this objective and suggested ways to accomplish it. Therefore, despite the API efforts to conform to ANSI rules, the CSB has concluded that the actual voting composition of the committee, and the limited participation and input from other sectors (e.g., environmental, government, public interest) and relevant scientific disciplines were inconsistent with the language and the intent of the recommendation.

2. **The document lacks explicit requirements in the form of "shall" language for the essential elements of an effective fatigue management system.**

Nearly all sections of the RP, as well the accompanying TR, use the word "should" rather than "shall" for activities that, by the RP's own logic, are necessary for the success of a fatigue prevention program. This recurrent absence of requirements or "shall" statements for management action is inconsistent with the intent of the recommendation. ANSI and voluntary

consensus standard practice is that "shall" statements are the minimum expectations of a standard, while "should" statements are those actions that are simply suggested. This distinction is typically described in prefaces for API ANSI standards. In the case of RP 755, the preface states that:

> *As used in this document, "shall" denotes a minimum requirement in order to conform with the recommended practice. "Should" denotes a recommendation or that which is advised but not required in order to conform to the recommended practice.*

This convention is accepted in other ANSI and similar voluntary standards in the U.S. and across the world (e.g., standards by ISO, or the International Organization for Standardization). In effect, the use of the word "should" for most elements of a Fatigue Risk Management System (FRMS) in the RP means that they are optional, not required. In what is already a voluntary standard to begin with—employers can choose to conform to them, but they are not required by force of law to do so—"should" statements have very little force.

The common use of the word "should" is also directly in contradiction to the approach in the existing ANSI Standard for Occupational Health and Safety Management Systems (ANSI/AIHA Z10, 2005),[3] as well as other existing management system standards, which routinely define numerous and very clear obligations for employers. This key ANSI standard is also not listed as a normative reference[4] in the RP, despite the fact that the RP asserts that effective fatigue management "can only occur in the presence of an effective Fatigue Risk Management System integrated into the facility's overall safety management systems."

The use of the word "should" rather than "shall" can be found in critical sections of the RP including:

- Written fatigue policies and procedures established by management (Sections 1, 4.1);
- The designation of specific management staff with accountability for the FRMS (Section 4.1);
- The integration of the FRMS with a site's other management systems (Section 1.1);
- The conduct of assessments of workload and staffing needs during normal operations, as well as during high-risk start-ups and shutdowns, or unplanned events (Section 4.3);
- The control of other factors that may contribute to fatigue such as lighting and ventilation (Section 4.5);
- The consideration of fatigue as a potential risk factor during incident investigations (Section 4.7); and,
- The periodic review of the FRMS for continual improvement (Section 4.9).

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[3] This standard was revised in 2012, but it was not changed in any way that would materially affect this evaluation.

[4] According to ANSI and other standard bodies, a normative reference is one that is "indispensable for the application of the standard," which is understood to mean a reference that is expected to be followed if one is to conform to the standard.

3. **The document places undue emphasis on "soft" or "personal" components of fatigue control, such as self-evaluation by employees, evaluation by supervisors, and training and education, without supporting scientific evidence of their efficacy.**

Section 4.6 (Individual Risk Assessment and Mitigation) states that employees should self-determine if they are too fatigued to work safely. Specifically, the section states that "Companies *shall* (italics added) encourage individuals to be continuously aware of their level of fatigue and take appropriate steps to enhance their alertness while on duty," although there is no guidance about what such "steps" should be in the event a worker feels too fatigued. The RP goes further to say that employees "*shall* (italics added) report to their supervisors" "if and when they are too fatigued to work safely," again without further explanation of what is expected to happen when they do so or how such self-reports should be handled.[5] The section also contains two "shall" statements concerning the obligations of supervisors to identify fatigue among their subordinates and the supervisors' authorities to "take appropriate steps" (though these remain entirely undefined).[6]

The basic guidance in this section, for both employees and supervisors, runs contrary to widely supported research findings that individuals are very poor judges of their personal level of fatigue[7] and the impact of fatigue on their performance, especially as the period of wakefulness increases.[8] Indeed, the TR itself makes this point by stating that "people are often poor judges of their level of fatigue and the extent that fatigue may negatively affect their performance" (TR, p. 30). Thus the technical guidance to the RP contradicts the efficacy of these "shall" statements focused on individual workers and supervisors.

This is also one of the few sections of the RP where "shall" statements appear at all, a fact which illustrates the emphasis of the RP on "personal" methods for the control of fatigue, focused on individual workers or supervisors and their behavior, rather than adequate staffing and limitations on hours of work and related measures.

Training and education of employees are no doubt valuable components in a comprehensive program to reduce fatigue risk. The basic elements of a fatigue prevention program, however, must still be sufficient staffing and the establishment of preventive limits on hours and days of work, overtime and related measures, along with clear management responsibility for the control of these and other workload risk factors. The CSB recommendation was focused on such limits

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[5] The RP contains no language that describes what happens to an employee who self-reports, how the shift is filled, who ultimately decides if the employee is too fatigued to work, and whether the employee could be disciplined for the self-report.

[6] In comparison, the nuclear industry regulation on work hours, 10 CFR 26.211 describes the conditions in which fatigue assessments should be conducted, the components of a fatigue assessment, and written requirements necessary to document the assessment.

[7] Health Safety Executive, "HSE Human Factors Briefing Note, No. 10, Fatigue," http://www.hse.gov.uk/humanfactors/topics/10fatigue.pdf

[8] Van Dongen HPA, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *SLEEP* 2003; 2: 117-126.

as the primary element of fatigue risk management, unlike the RP's emphasis on the "soft" components.

4. **Although the RP requires limits on hours and days at work, the limits are generally more permissive, and therefore less protective, than those suggested by current scientific knowledge. The permissive limits are based on an unproven assumption that implementation of a particular FRMS will "compensate" for the risk from excessive hours and days at work.**

Section 4.8 (Hours of Service Limits) and especially Table 1 of the RP should address one of the core objectives of the CSB recommendation, which is to "at a minimum, limit hours and days of work." The section, however, has a serious internal contradiction and lack of clarity in its requirements. This is due to the weakening of the limits that occurs because of a postulated but unproven "compensatory" value of having an FRMS,[9] as well as the use of non-mandatory "should" statements in this section and throughout the document.

The section defines hours-of-service limits under three scenarios in what appears to be, at first glance, "shall" language, and which clearly states the condition that the limits can be effective only in the presence of an effective FRMS. Specifically, Section 4.8 states: "These limits have been developed in the context of the existence of a comprehensive FRMS. Consistently working at the limits shown *is not sustainable and may lead to chronic sleep debt* (italics added). The overall FRMS shall be designed to prevent employees from frequently working at or near these limits over the long term." There are identical warnings in the TR (Pages 38 & 40). The limits can only be effective if an FRMS is in place, yet, as described above, the RP does not require ("shall") the establishment of an FRMS, or most of its necessary components. If all the components of an effective FRMS are not required by "shall" statements, it calls into question the force of Table 1 (Hours of Service Guidelines, p. 9, RP).

It is noteworthy that the United Kingdom's Health and Safety Executive issued a cautionary "HSE Statement on the API Fatigue Standard" stating:

> *Employers should also note that the 'hours of service guidelines' as outlined in API RP 755, have been developed in the context of the existence of a comprehensive FRMS, where the limits are intended to act as triggers for further risk assessment and not as working time limits. Consistently working to the limits is not sustainable and may lead to chronic sleep debt and would be considered unacceptable in the UK where rapid rotation of shifts and shorter weekly hours are considered good practice.*[10]

The accompanying TR repeatedly discusses the basis for the hours of service limits in Table 1 as being at the edge or beyond the limits of the acceptable range based on existing science, but presumably these stretched limits are acceptable because of the presence of an FRMS. An FRMS thus compensates for limits that are more permissive than science would indicate. This is

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[10] See http://www.hse.gov.uk/humanfactors/resources/articles/api-fatigue-standard.htm

most clearly demonstrated on page 39 of the TR, which asserts that "Since a company with a RP 755-compliant FRMS will evaluate and actively mitigate a significant number of other factors that contribute to fatigue… it seems reasonable to allow some flexibility regarding the hours of service limits…" Yet the RP does not provide evidence that an FRMS would in fact compensate for permissive time limits. This contradiction severely undermines the table limiting hours, which was designed to address the central goal of the CSB recommendation.

There are several instances where the TR document describes the RP's recommended limits as beyond those supportable by current scientific evidence. Following are three important examples:

- Page 45 of the TR reports that more than 60 hours of work per week, or more than 5 consecutive 12-hour days, is associated in the scientific literature with a number of fatigue-related ill effects, including reduced safety, yet the RP permits a maximum of 7 consecutive days under normal operations.
- The RP doubles the permissible number of consecutive 12-hour days to 14 during outages, regardless of whether they are planned or unplanned, drawing no distinction for those instances when workload and staffing can be planned, as in planned shutdowns and start-ups. The same discussion admits that "it should be acknowledged that the fatigue risk of 14 consecutive 12 or 10 hour shifts in operations with daily commuting shiftworkers has not been studied by peer reviewed science." Indeed, the underlying support in the TR for these permissive limits during outages is unclear. The TR makes an apparently unsupported assertion that "under the conditions of outage…employees have planned their lives to minimize outside obligations," so that "conditions may become closer to those of a remote location facility than a commuting situation." (see pp. 51-52) Likewise, on page 52, the TR asserts without evidence that "specific training" and "tips on how to improve sleep quality" are sufficient to achieve restful sleep and avoid fatigue under stressful worksets. In comparison, the nuclear industry regulations pertaining to work hours, 10 CFR 26, maintain the same number of work-hour and day restrictions during outages for specified critical personnel, and provide minimum "day off" requirements during outages for those employees (e.g. 3 days off in a 15-day period of work for operators [10 CFR 26.205(d)(4)]).[11]

This example is of particular concern because the CSB Texas City investigation found that the ISOM unit was coming off a scheduled (planned) outage at the time of the incident, and many employees were likely fatigued because they had been working an excessive number of consecutive days. The key point is that when units are brought back online after an outage, many factors contribute to potentially increased risks. Temperatures, pressures and flows can change rapidly, more manual intervention/action is required, and sudden and unexpected events are more

[11] The nuclear industry regulation on work hours, 10 CFR 26, states that "…licensees shall ensure that any individual's work hours do not exceed the following limits: a.) 16 work hours in any 24-hour period; b.) 26 work hours in any 48-hour period; c.) 72 work hours in any 7-day period" during both normal operations [10 CFR 26.205(d)(1)(i-iii)] and times of planned outages [10 CFR 26,205(d)(3)(i-v) and 10 CFR 26,205(d)(4). These work hour rules have exceptions during times of emergency or conditions adverse to safety and security, and can only be waived during such times after the supervisor/manager performs an assessment of the employee's previous 14-day work history to ensure that fatigue will not detrimentally affect performance [10 CFR 26.207(a)(1)(i-ii)]..

likely. Usually the work is less familiar to the employees than the work performed on a regular day-to-day basis. In fact, Center for Chemical Process Safety states that 60 to 75% of major incidents in continuous processes occurred during non-routine modes of operation.[12] Shutdown and start-up periods are significantly more risky than normal operation. Thus additional care should be taken to ensure employees are not fatigued during start-ups following outages.

- Finally, page 59 of the TR states that "working 19 consecutive 8-hour shifts exceeds by far the standard scientific recommendations," yet that is precisely the number allowed by the RP during outages.

The logic of the RP and the TR documents is that limits on days and hours (and other workload factors) should be more permissive during outages, even when those outages are planned. But the evidence is that outages or turnarounds, and the transitional times between them and start-ups and shutdowns, are the riskiest times for refineries and other chemical facilities. The RP could have emphasized the possibilities of increased staffing during such times. Although there can be extraordinary circumstances that may demand extended work periods, a fatigue standard should be aimed at minimizing such instances, particularly during outages or turnarounds.

Finally, Section 4.9 of the RP is also the only one that specifically mentions "open shifts."[13] The USW had proposed that the RP require reductions in "open shifts" and establish "open shift" reduction benchmarks and goals across the industry. The RP did not adopt this USW proposal, but opted instead for "should" language with regard to open shifts, rather than pursuing open shifts as an easily measureable and thus potentially valuable leading indicator of fatigue risk. The number of open shifts on the schedule can be tracked over time as an indicator, where an increase in the number would indicate a potential workload and fatigue hazard, and the possible need to increase staffing.

5. Conclusions of the Evaluation

In summary, RP 755 makes a contribution to chemical safety by explicitly stating that "workplace fatigue is a risk to safe operations," and also by suggesting numerous measures to manage fatigue risks, especially the need for limits on hours of work and similar measures. But as the above analysis indicates, API RP 755 falls short of what a fatigue standard should require of employers, and does not fully meet the intent of the CSB recommendation in four major areas, as follows:

- **The document was not the result of an effective consensus process, and therefore does not constitute a tool that multiple stakeholders in the industry can "own." It was not balanced in terms of stakeholder interests and perspectives, and did not sufficiently incorporate or take into account the input of experts from other industry sectors that have addressed fatigue risks.**

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[12] CCPS, *Guidelines for Hazard Evaluation Procedures*, 3rd Edition, Chapter 9, page 257.

[13] Open shifts are defined in API 755 as "foreseeable or planned vacancies where the vacancy is known at least one week in advance and overtime will be required to fill the vacancy (non-emergency)." [*Recommended Practice ANSI/RPI 755, Fatigue Risk Management Systems for Personnel in the Refining and Petrochemical Industries,* First Edition, April 2010.]

- **The document lacks explicit requirements in the form of "shall" language for the essential elements of an effective fatigue management system.**

- **The document places undue emphasis on "soft" or "personal" components of fatigue control, such as self-evaluation by employees, evaluation by supervisors, and training and education, without supporting scientific evidence of their efficacy.**

- **Although the RP requires limits on hours and days at work, the limits are generally more permissive, and therefore less protective, than those suggested by current scientific knowledge. The permissive limits are based on an unproven assumption that implementation of a particular FRMS will "compensate" for the risk from excessive hours and days at work.**

Consequently, the status of this recommendation should be designated as: "Open—Unacceptable Action." This status allows for further improvements in the Recommended Practice to make it more consistent with the goals of the CSB recommendation, with the potential for a "Closed — Acceptable Action" status in the future.