

Date: 8 May 2022

To: Pacific Islands Forum Secretariat

From: **Independent Expert Panel**

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Subject: **Supplement to the memorandum of 8 March 2022 entitled “Concerns and recommendations regarding the discharge of cooling water from the Fukushima Nuclear Power Plant” following the receipt of data from TEPCO**

Our memorandum of 8 March 2022 outlined serious concerns regarding TEPCO’s plan to begin discharging more than one million metric tons of radioactively contaminated water into the Pacific Ocean in the first part of 2023. We expressed the view that it would be premature to accept the plan, given the insufficiency of essential data and analysis, detailed information on sampling design, testing protocols and associated QA/QC, among other considerations. At that time, we awaited TEPCO’s response to data requests and questions that the Pacific Islands Forum had sent to Japan on our behalf.

This memorandum supplements our 8 March 2022 communication. We have prepared it because we received a considerable amount of data, including a large spreadsheet containing radionuclide sampling data.

We met on May 4 (US time zones)/May5 (Fiji-Australia time zones) to discuss the information provided. For the reasons stated below, we reaffirm our earlier concerns. As described below, they have in fact been heightened by the form and substance of the data we received and, as much, by what we did not receive.

The reasons for our continued and reinforced concerns are as follows:

1. We requested data on all 62 radionuclides contained in the tanks. We received data on 742 samples, 13% of those were not related to radionuclide measurements, 86% of the samples

focused only on 11 isotopes, and the final 1% of samples measured 20 radionuclides of which 8 overlapped with the 11 isotopes. To be clear of the 742 samples only five tanks were assessed for the concentration of 20 isotopes.

2. From what we have seen after receiving the data, our earlier conclusion that only a small fraction of the tanks (about 20 percent or less) have been sampled. No information on statistical design or any power analyses for the requisite number of samples needed was provided.
3. Even the above two considerations by themselves – a lack of data on most radionuclides and from most tanks – would be sufficient to conclude that a decision to discharge was premature, at best. But our concerns now extend to the data itself.
4. We received an extensive amount of data, but it was in a jumbled format. For instance, the radionuclide data were not aligned in the spreadsheet, making it impossible to apply the normal tools of data analysis without extensive work. As another example, the units were inconsistent – some data points were reported in units of Bq/cc and others in units of Bq/L, meaning the same concentration in the latter unit would be a number 1,000 times higher than the former. There was also no separate column specifically dedicated to the specific tank that was assayed. In order to even examine the data, we had to line up all the radionuclide columns, check the units for each data point and make the entire dataset consistent. This was a huge task that took a large amount time and resources. None of us have ever seen a data request with such a shoddy response, essentially lacking in normal scientific courtesy and protocol.
5. We were surprised to receive the data in a form that is not suitable for analysis. If TEPCO has data in a suitable format, we question why that was not been provided to us, instead of the data as described above. We do not believe that TEPCO could have done any analysis with data in the format in which it was sent to us. As a result, assuming that TEPCO has actually done some analysis, we have concerns and questions about why the data were sent to us in an unusable format.
6. In the term “analysis of the data” we include calculating minimum, maximum, average and median concentrations of each radionuclide in each tank. This is essential for understanding how the dilution and discharge would actually be carried out and how long it might take. Such an analysis may also provide indications of how effective (or not) the ALPS system may be. As we noted in our earlier communication, only two tanks have been treated and that too, only in part. This is a very unsatisfactory and incomplete basis on which to take such a momentous decision. An example of the kind of analysis that a well-organized set of data would allow is provided by the article that one of us, Ken O. Buesseler, wrote in 2020, about the very issue of the contents of the tanks and proposed discharges (Ken O. Buesseler, “Opening The Floodgates at Fukushima”, *Science*, Vol, 369, No. 6504, 7 August 2020, pp. 621-622 at <https://www.science.org/doi/10.1126/science.abc1507>). Dr. Buesseler had to compile that data himself for this article. To compile data from the spreadsheet provided now so that it could be a part of a timely and meaningful discussion about the discharges is now essentially impossible, given the late date, the volume of data, and the poor condition it is in.
7. Some of our concerns related to the data itself. For instance, we note that the implied limit of detection for cesium-134 varied by a factor of more than 400 between samples. No explanation was provided. We had asked for details about sampling methods and analytical techniques, but these have not been forthcoming to the degree that would explain such anomalies.

8. As another concern, we note from the data previously compiled by one of us (ref. #9 in above article), is that the range between the minimum and maximum concentrations of different radionuclides are very large. For example, the ratio between the maximum/minimum concentration is nearly seven million in the case of strontium-90, a critical radionuclide from both an ecosystem and radiation safety point of view. It is about 13,000 for cesium-137, also a critical radionuclide. No explanation for such huge range in individual radionuclide concentrations between tanks has been provided. Also of concern is that the relative concentrations between radionuclides varies widely in individual tanks. For example, the strontium-90 to cesium-137 ratio in individual tanks varies by a factor of more than 6 million. This indicates variability in the ALPS system not just in its overall efficiency of total radionuclide removal, but variability over time in the ability to remove individual radionuclides at a constant efficiency relative to each other. It is critical to understand such issues because they may well relate to the efficiency with which the ALPS system will operate as proposed for secondary clean up of more than 70% of the tanks, as well as for understanding whether and how ALPS efficiency has varied in the past.
9. Another example of reinforced concerns relates to dilution volume. TEPCO has stated that a dilution of more than 100 times would be required without stating the precise average dilution factor. The data indicates that the dilution required would range from no dilution to a dilution factor of more than 1,600 times. Given that most tanks have not been sampled, the maximum dilution required may well be higher. This raises a host of operational and cost issues. How long will the operation go on? Will the size and quantity of equipment now envisioned be affected? It is possible that TEPCO has some answers to these questions, but we cannot infer them from the data provided.
10. We had an earlier question about whether there was sludge in any of the tanks. It is now confirmed that the answer is in the affirmative. This also raises a host of questions and new concerns:
 - a. How many tanks have developed sludge layers?
 - b. What is the consistency of the sludge? Does it vary by tank?
 - c. What is the vertical profile of radionuclide concentrations, given that the tank contents are not being agitated? Has sampling to determine vertical profiles been carried out?
 - d. What fraction of each radionuclide is in the sludge compared to that in solution?
 - e. Have certain radionuclides selectively separated out into sludges?
 - f. Have the sludges been sampled? If so, was that data included in the estimation of the total source term?
 - g. Will the sludges be completely removed, diluted and discharged?
 - h. If some sludges remain in the tanks, how does that impact an assessment of site safety, given that they would still contain significant amounts of radioactivity?
 - i. How will the tanks be decommissioned if they have significant amounts of residual radioactivity? Will some, many or all be left on site?
11. The sludge question has also raised in our minds the problem of the safety of the storage of the separated radionuclides, including especially strontium-90. The intense radioactivity of separated material poses long-term storage concerns. ALPS separated radionuclides will add to this burden. It is essential that site safety as well as ocean ecosystem protection from future discharges, seismic events, or accidents be evaluated as a whole. The fact that radionuclides like

strontium-90 and cobalt-60 exhibit very high bioconcentration properties was already a concern (Buesseler 2020, op cit.) makes it essential to address this issue fully. We raise it in part to gain clarity of how the whole process of processing the waste again using ALPS and discharging the liquids into the Pacific will impact safety, risk, and ecosystem protection.

Given the issues described above, we continue to be concerned that IAEA has approved the discharge in principle. We would welcome a conversation with the IAEA team reviewing the matter, along with the opportunity to review the data that TEPCO and Japan may have provided that we may not have seen.

In sum, our concerns after receiving the data from TEPCO have only increased both as regards process and the substance of the matter. Since the proposed time of discharge in the first part of 2023 is fast approaching, the issues that we have raised take on even greater urgency. In the meantime, we stand by our earlier recommendation that “that PIF Members reject the proposed TEPCO action at this time until the concerns we have raised are fully and transparently addressed. The issue of support for the plan or the question of other alternatives can be evaluated at that time with the full consideration that a decision of this magnitude deserves.” Indeed, we now have additional concerns.