Purpose of agenda item

- Follow-up on panel recommendations from November 2010 meeting
- Propose an approach for screening possible candidates for designation to bring to SGP
- Illustrate the approach with the example of non-halogenated organophosphate flame retardants (PFRs)
- Obtain Panel input on both the approach and the example
Issues for the Panel to consider

- Usefulness of proposed screening approach
  - Are there elements you would add or delete?
  - Is this enough information for the Panel to choose possible candidates for designation?

- For the example of PFRs,
  - Are there specific chemicals the Program should consider bringing back for potential designation?
  - Should the Program consider preparing a document on a class of PFRs?
Screening approach

- Search for data on extent and type of use, including trend
- For chemicals with evidence of significant use, brief search of literature & secondary sources for:
  - Indicators of:
    - Environmental persistence
    - Bioaccumulation
    - Toxicity
  - Past environmental sampling and biomonitoring studies
- Panel reviews summary of above information and advises on possible candidates
# Example Screening Table

<table>
<thead>
<tr>
<th>Chem</th>
<th>Type of use</th>
<th>Vol [Trend]</th>
<th>Persistence (P)</th>
<th>Bioaccumulation (B)</th>
<th>Tox</th>
<th>Environ Sample</th>
<th>Biota Sample</th>
<th>Biomon Study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>P US EPA</td>
<td>B LogK_ow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XYZ</td>
<td>consumer product</td>
<td>1-10 M [↑]</td>
<td>++</td>
<td>5.0</td>
<td>✓</td>
<td>house dust</td>
<td>bird eggs</td>
<td>urine; blood</td>
</tr>
</tbody>
</table>
Non-halogenated organophosphate flame retardants (PFRs)
Uses

- Flame retardants
- Plasticizers
- Other: anti-foaming agents, wetting agents, anti-wear additives
- Example applications:
  - Computers and household electronics
  - Polyurethane foam and textiles
  - Artificial leather and synthetic rubber
  - Floor polish
  - Hydraulic fluids
Examples of PFRs

Triphenyl phosphate

t-Butylphenyl diphenyl phosphate (one isomer)

Tris(2-butoxyethyl) phosphate
## Screen of aromatic PFRs, 10–50 mil lbs (2006)

<table>
<thead>
<tr>
<th>Aromatic PFR [trend]</th>
<th>Persistence (P)</th>
<th>Bioaccumulation (B)</th>
<th>Tox</th>
<th>Environ Sample</th>
<th>Biota Sample</th>
<th>Biomon Study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>US EPA</td>
<td>LogK&lt;sub&gt;ow&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triphenyl phosphate</td>
<td>+</td>
<td>4.59</td>
<td>✓</td>
<td>house dust, computers</td>
<td>dolphins, bird eggs</td>
<td>urine; plasma, breast milk</td>
</tr>
<tr>
<td>Isopropylated triphenyl phosphate [↑ Nordic]</td>
<td>++</td>
<td>5.44</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t-Butylated triphenyl phosphate [↑ US]</td>
<td>++</td>
<td>4.85</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bisphenol A bis(diphenylphosphate) (rxn products) [↑ US]</td>
<td>(High concern)</td>
<td>(High concern)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Screen of aromatic PFRs, 1–10 mil lbs (2006)

<table>
<thead>
<tr>
<th>Aromatic PFR [trend]</th>
<th>Persistence (P) Bioaccumulation (B)</th>
<th>Tox</th>
<th>Environ Sample</th>
<th>Biota Sample</th>
<th>Biomon Study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P US EPA</td>
<td>B LogK\text{ow}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tricresyl phosphate</td>
<td>++</td>
<td>5.11</td>
<td>✔</td>
<td>house dust</td>
<td>not found (urine)</td>
</tr>
<tr>
<td>2-Ethylhexyl diphenyl phosphate</td>
<td>+</td>
<td>5.73</td>
<td></td>
<td>bottom-dwelling fish</td>
<td>breast milk</td>
</tr>
<tr>
<td>Isodecyl diphenyl phosphate</td>
<td>++</td>
<td>5.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Screen of non-aromatic PFRs, 1–10 mil lbs (2006)

<table>
<thead>
<tr>
<th>Non-aromatic PFR [trend]</th>
<th>Persistence (P)</th>
<th>Bioaccumulation (B)</th>
<th>Tox</th>
<th>Environ Sample</th>
<th>Biota Sample</th>
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<tr>
<td></td>
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<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>US EPA</td>
<td>LogK&lt;sub&gt;ow&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tris(2-butoxyethyl) phosphate [↓US, Nordic]</td>
<td>—</td>
<td>3.75</td>
<td>✓</td>
<td>dust, computer drinking water indoor air</td>
<td>bird eggs indoor air breast milk, adipose tissue</td>
<td></td>
</tr>
<tr>
<td>Tri-n-butyl phosphate</td>
<td>+</td>
<td>4.00</td>
<td>✓</td>
<td>indoor air</td>
<td></td>
<td>breast milk</td>
</tr>
<tr>
<td>Triethyl phosphate [↑Nordic]</td>
<td>—</td>
<td>0.8</td>
<td></td>
<td>indoor air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bis(2-ethylhexyl) phosphate</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examples of toxicity information

- Triphenyl phosphate
  - Associated with decreased fertility and hormone alterations in men

- Isopropylated triphenyl phosphate
  - Neurotoxic in hens

- $t$-Butylated triphenyl phosphate (tBuTPP)
  - Lubricant oil containing 3% tBuTPP neurotoxic in hens
Toxicity: Data gaps for PFRs

- Consumer Product Safety Commission nominated representative aromatic PFRs to National Toxicology Program (NTP) for testing:
  - t-Butylphenyl diphenyl phosphate
  - 2-Ethylhexyl diphenyl phosphate
  - Isodecyl diphenyl phosphate
  - Isopropylated triphenyl phosphate
  - Tricresyl phosphate
  - Triphenyl phosphate
Toxicity: NTP research on PFRs

- Short-term screening evaluation of aromatic PFRs as a class
  - Effect of structure
  - Toxicity of mixtures
  - Endpoints include: neurotoxicity, reproductive toxicity, steroidogenesis, liver enzymes

- In-depth testing of two aromatic PFRs:
  - Developmental toxicity studies
  - Two-year carcinogenicity studies
    - Adult exposure in mice
    - Perinatal exposure in rats
Questions?
Limitations of screening approach

- Volume does not reliably indicate extent of use
  - US volume information is out of date
  - Chemicals in imported products not included
- Difficult to represent subtlety of information in tabular form
  - Mixtures vs. specific isomer
  - Checkmark (✓) for toxicity
  - Environmental sampling results
- Brief search may miss important information
Questions for Panel

- Is this a useful screening approach for identifying possible candidates for designation?
- Are there elements you would add or delete?
- Would a summary table be enough information for the Panel to choose possible candidates for designation?
For the specific example of PFRs,
- Does the Panel want to see particular PFRs brought back for potential designation?
- Does the Panel want to see a group of chemicals (e.g., aromatic PFRs)?