**Supplementary figure 1**

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| --- | --- | --- | --- |
| **Mutation** | **pH** | **Temperature (°C)** | **Predicted free Gibbs energy change value (ΔΔG)** |
| VP1-L97R | 7 | 25 | -0.65  (Destabilizing) |
| 5 | 25 | -0.70  (Destabilizing) |
| 7 | 55 | -0.51  (Destabilizing) |
| VP1-E167G | 7 | 25 | -1.15  (Destabilizing) |
| 5 | 25 | -1.10  (Destabilizing) |
| 7 | 55 | -0.74  (Destabilizing) |
| VP1-E145Q | 7 | 25 | -0.80  (Destabilizing) |
| 5 | 25 | -0.89  (Destabilizing) |
| 7 | 55 | -0.71  (Destabilizing) |