Scalable PHP Web Application on AWS using ALB & Auto Scaling

🧩 PROJECT GOAL

The goal of this project is to design and implement a **scalable PHP web application on AWS** where:

- Users access the application through **a single public URL**
- Incoming traffic is **automatically load balanced**
- Backend servers **scale up and down automatically** based on CPU load
- High availability is ensured using **multiple Availability Zones**

🔧 Core AWS Services Used

- Amazon EC2
- Application Load Balancer (ALB)
- Auto Scaling Group (ASG)
- Amazon CloudWatch

🧱 STEP 1 — Launch EC2 & Host PHP App (FOUNDATION)

🎯 Objective

Create a **single working PHP server** that will later be used as the **reference template** for scaling.

✅ 1. Launch EC2 Instance

AWS Console → EC2 → Launch instance

Configuration:

- AMI: **Amazon Linux 2023**
- Instance type: **t2.micro**
- Key pair: Created and downloaded
- Security Group:
    - Allow **SSH (22)** from my IP
    - Allow **HTTP (80)** from anywhere

Instance launched successfully.

✅ 2. Connect to EC2

```
ssh -i yourkey.pem ec2-user@PUBLIC_IP
```

✅ 3. Install Apache & PHP

```
sudo yum update -y
sudo yum install httpd php -y
```

```
sudo systemctl start httpd
sudo systemctl enable httpd
```

✅ 4. Create PHP Test Application

```
sudo nano /var/www/html/index.php
```

```
<?php
echo "<h1>PHP App Working</h1>";
echo "Server IP: " . $_SERVER['SERVER_ADDR'];
?>
```

Restart Apache:

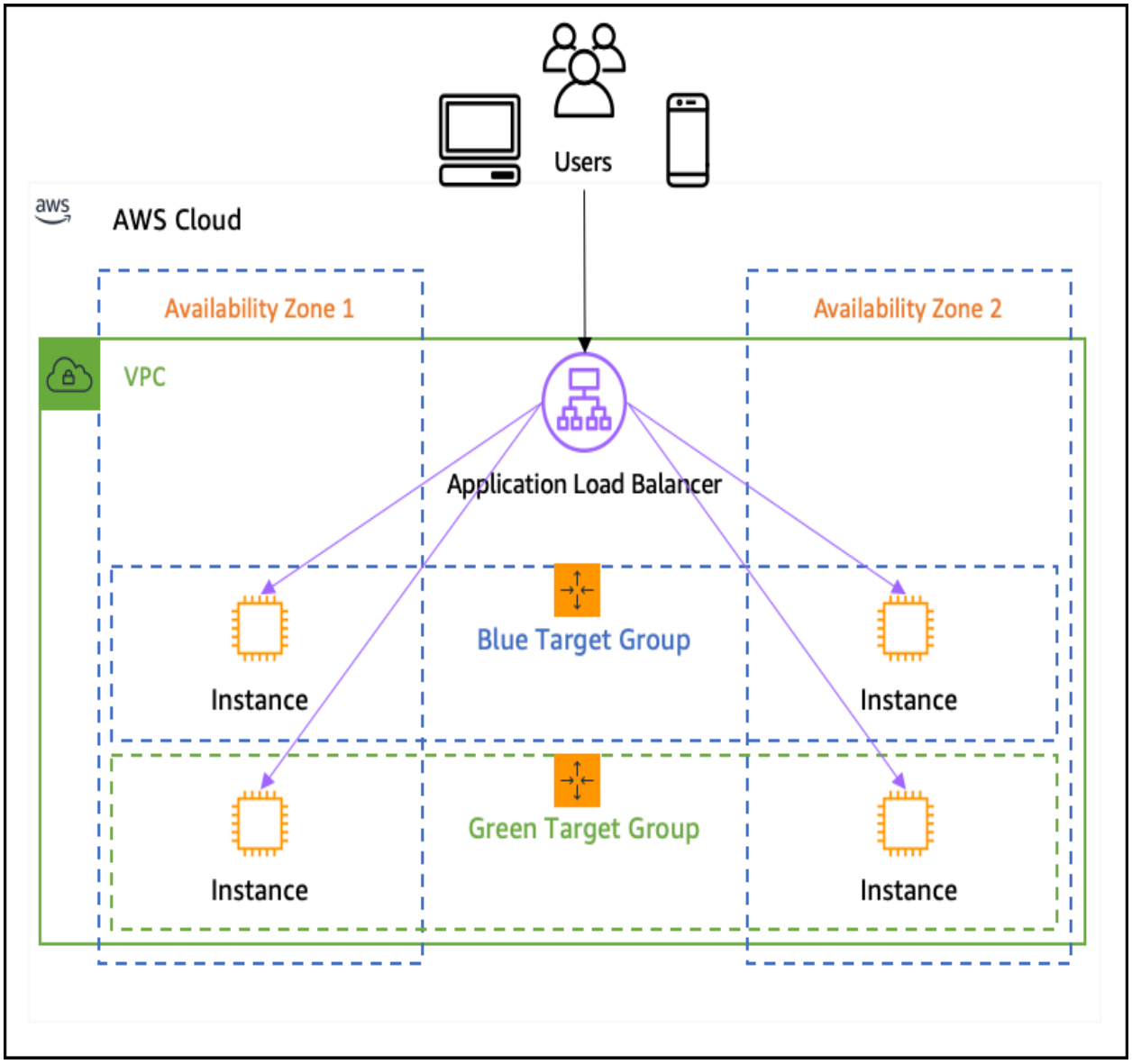
```
sudo systemctl restart httpd
```

✅ 5. Verification

- Open browser: `http://EC2_PUBLIC_IP`
- Page loads successfully
- Server IP is displayed

✔ PHP application is working correctly

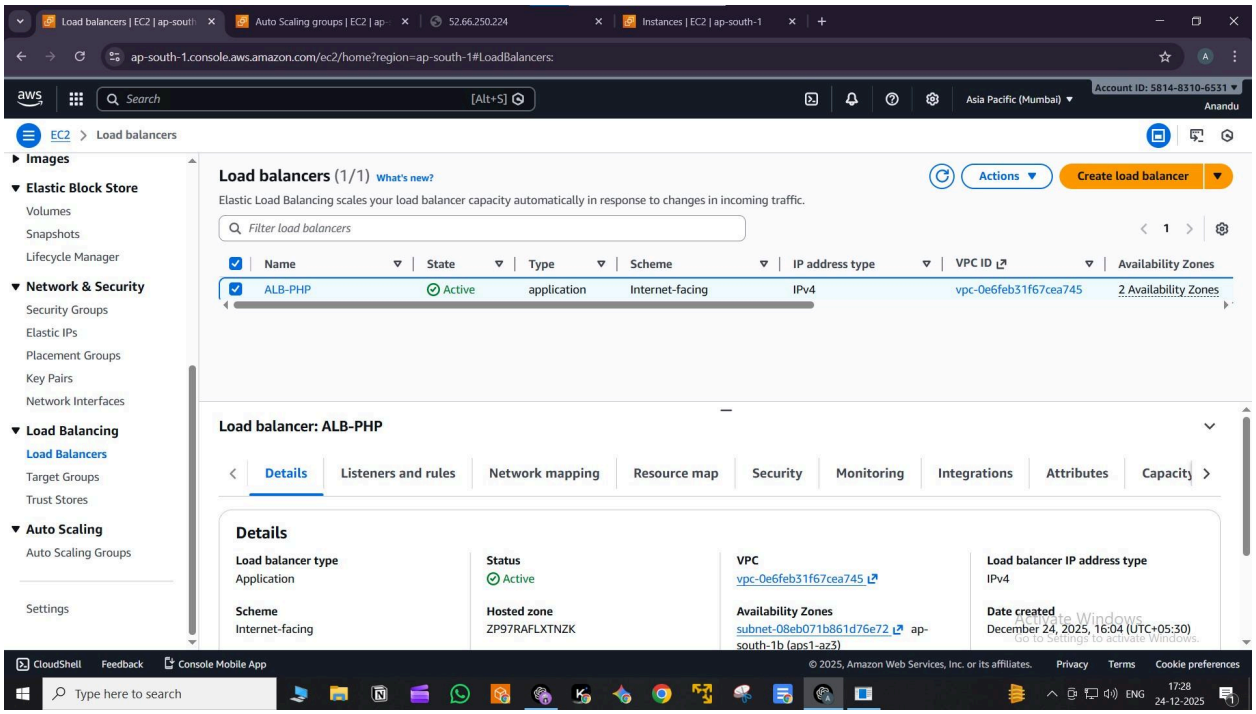
🧱 STEP 3 — Architecture Diagram



🧱 STEP 3 — Create Application Load Balancer (ALB)

🎯 Purpose

- Provide **one public entry point**
- Route traffic to EC2 instances
- Prepare the system for Auto Scaling.



✅ STEP 2.1 — Create Target Group (Mandatory)

AWS Console → EC2 → Target Groups → Create target group

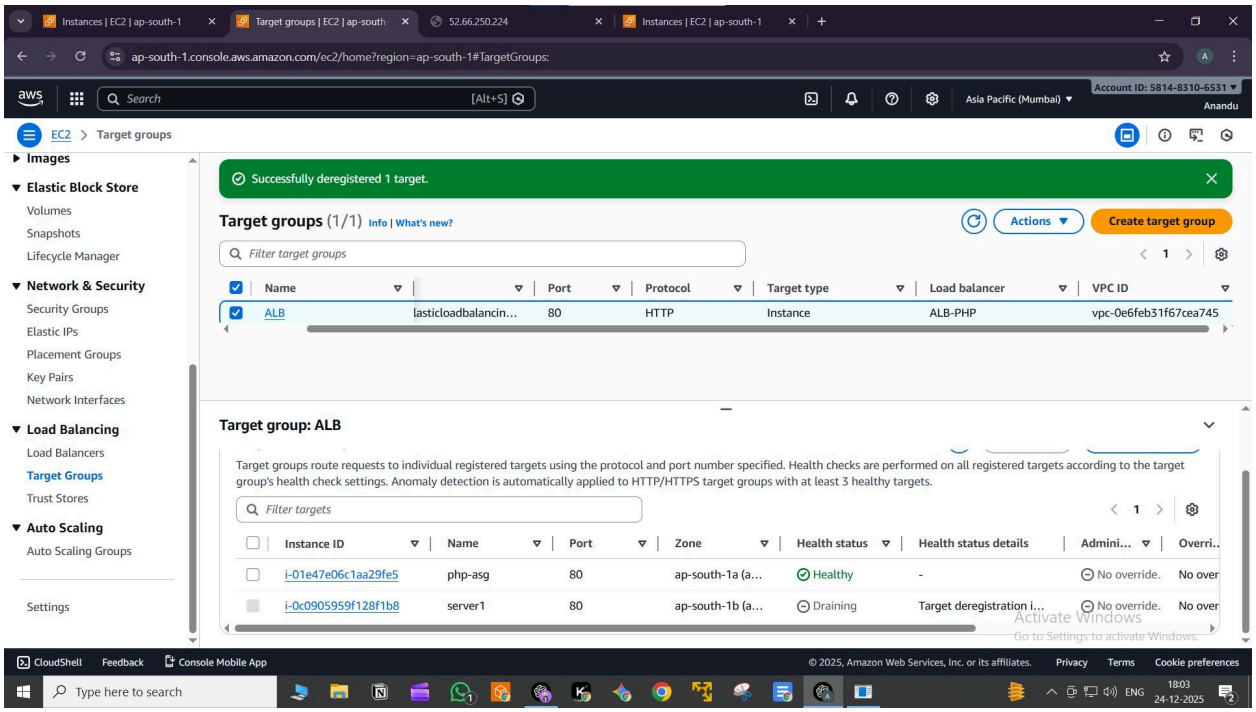
Configuration:

- Target type: **Instance**
- Protocol: **HTTP**
- Port: **80**
- VPC: Same as EC2
- Health check path: /

Register target:

- Select EC2 instance
- Include as pending
- Create target group

✅ Health status becomes **Healthy**



✅ STEP 2.2 — Create Application Load Balancer

EC2 → Load Balancers → Create load balancer

Configuration:

- Type: **Application Load Balancer**

- Scheme: **Internet-facing**
- Listener: **HTTP : 80**
- VPC: Same as EC2
- Subnets: Minimum **2 AZs**
- Forward traffic to target group: **ALB**
- Security Group: Allow HTTP 80 from `0.0.0.0/0`

✅ Expected Result

- Target Group shows:
  - Healthy: **1**
  - Unused: **0**
- Load balancer name appears instead of *None associated*

✔ ALB → Target Group → EC2 → PHP App path confirmed

🧱 STEP 3 — Create Launch Template

🎯 Objective

Define a blueprint so AWS can **automatically create identical EC2 instances**.

✅ STEP 3.1 — Create Launch Template

EC2 → Launch Templates → Create launch template

Configuration:

- Name: **php-launch-template**
- AMI: Amazon Linux 2023
- Instance type: t2.micro
- Key pair: Same as before
- Security Group: Same as EC2

⚠️ USER DATA (CRITICAL)

```
#!/bin/bash
yum install httpd php -y
systemctl start httpd
systemctl enable httpd

cat <<EOF > /var/www/html/index.php
<?php
echo "<h1>Auto Scaled PHP Server</h1>";
echo "<br>Server IP: " . \$_SERVER['SERVER_ADDR'];
?>
EOF
```

✔ Ensures every new instance is ready automatically
✔ No manual SSH required

Launch template created successfully.

🧱 STEP 4 — Create Auto Scaling Group (ASG)

🎯 Objective

- Automatically manage EC2 instances
- Attach instances to ALB
- Scale based on CPU load

✅ STEP 4.1 — Create Auto Scaling Group

EC2 → Auto Scaling Groups → Create Auto Scaling group

- Name: **php-asg**
- Launch template: **php-launch-template**
- Version: Default

✅ STEP 4.2 — Network & AZs

- VPC: Same as ALB
- Subnets: At least **2 AZs**

✔ Provides high availability

✅ STEP 4.3 — Attach Load Balancer

- Attach to existing load balancer
- Target group: **ALB**
- Health check type: **ELB**
- Grace period: **300 seconds**

✔ New instances auto-register
✔ Unhealthy instances auto-replaced

✅ STEP 4.4 — Capacity Settings

- Minimum: **1**
- Desired: **1**
- Maximum: **3**

✅ STEP 4.5 — Scaling Policy (Core Logic)

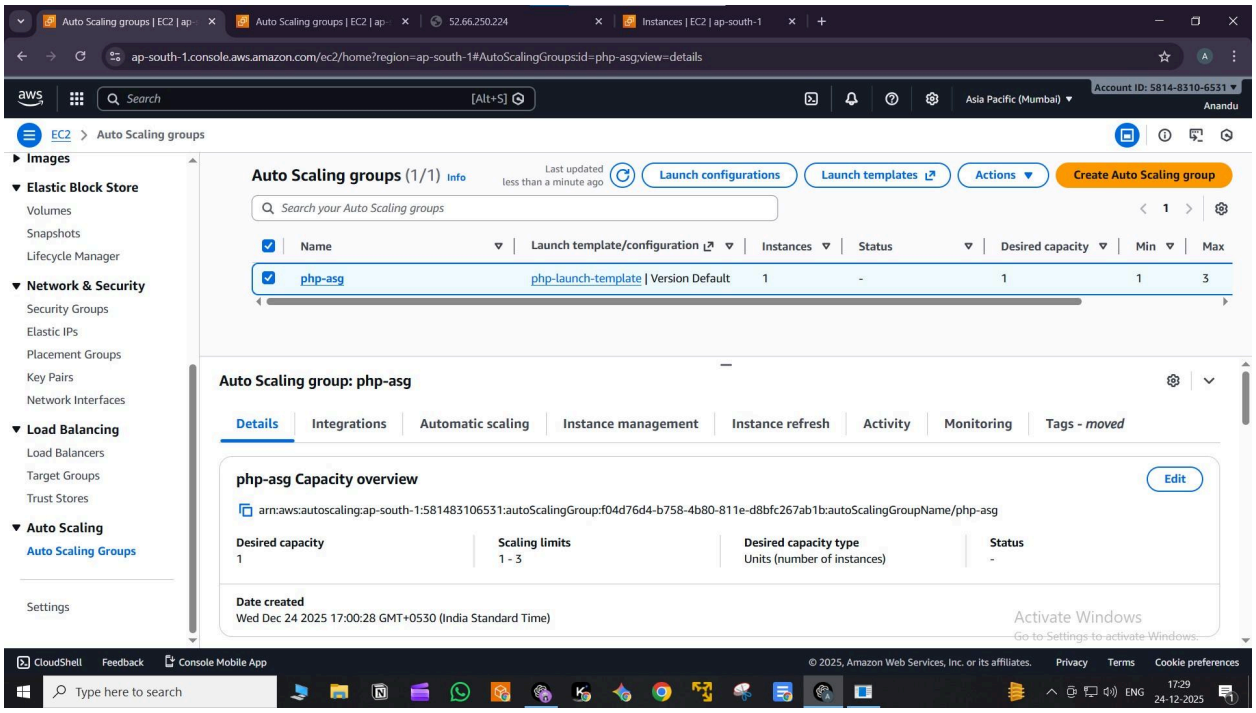
- Policy type: **Target tracking**
- Metric: **Average CPU utilization**

- Target value: **50%**

AWS behavior:

- CPU > 50% → Scale out
- CPU < 50% → Scale in

ASG created successfully.



✅ Verification

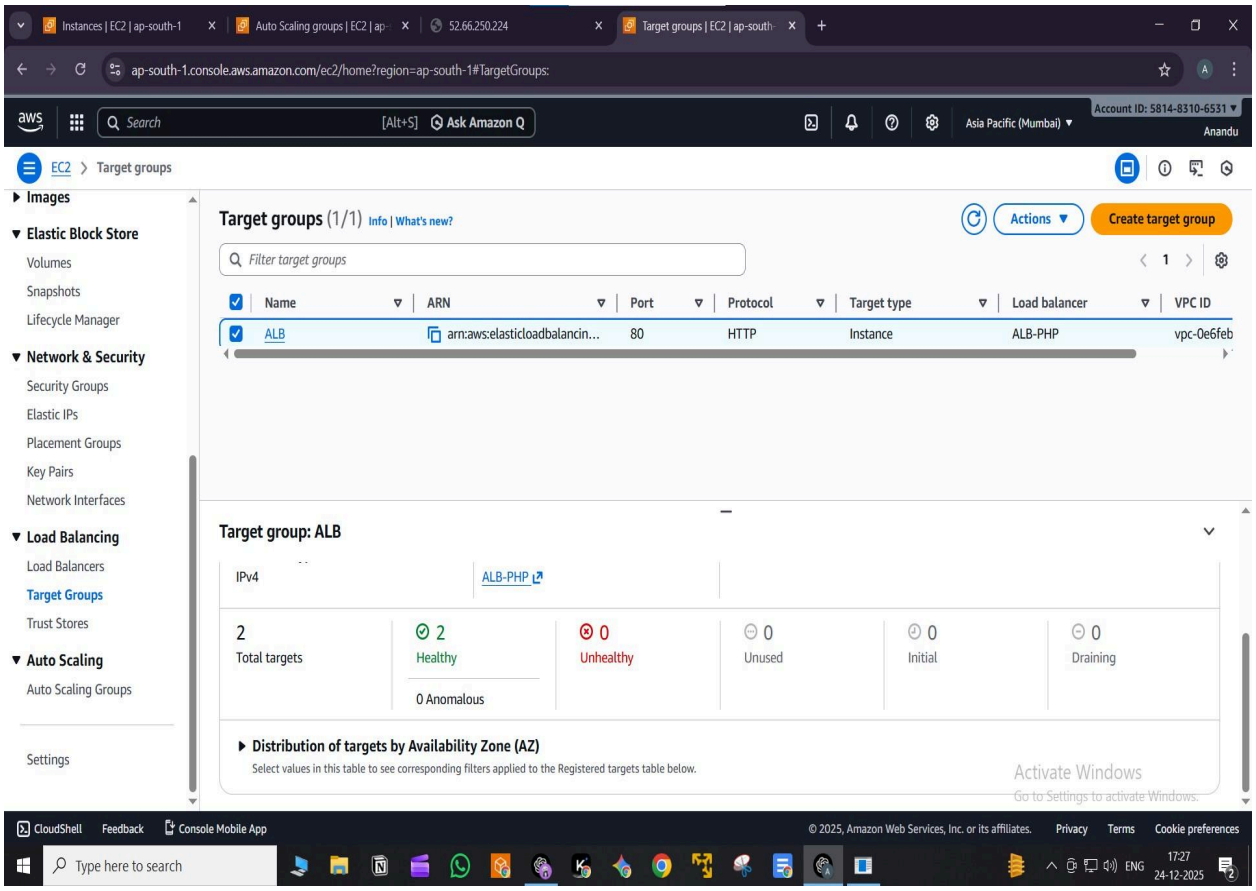
- ASG Activity shows: *Launching new EC2 instance*
- Target Group shows **2 healthy instances**

🎉 Auto Scaling is live.

🧠 Why Two Healthy Targets Appeared

Two EC2 instances were registered:

1. **server1** – manually created
2. **php-asg instance** – auto-scaled



ALB marks **any healthy instance as valid**, regardless of how it was created.

🧠 WHY SCALING DID NOT TRIGGER INITIALLY

Scaling metric used:

Average CPU utilization of Auto Scaling Group

Observed:

- php-asg CPU ≈ 83%
- server1 CPU ≈ 0%

Average CPU:

`(83 + 0) / 2 ≈ 41.5%`

🚫 Scaling condition (50%) not met
✅ System behaved **correctly**

🧭 **Deregister Manual EC2 (server1)**

EC2 → Target Groups → ALB → Targets

Steps:

- Select `server1`
- Click **Deregister**
- Wait ~60 seconds

Result:

- Total targets: **1**

- Healthy: **1**
- Only ASG-managed instance remains

🧭 Create Missing Scaling Policy (Fix)

ASG → Automatic scaling → Create dynamic scaling policy

- Type: Target tracking
- Metric: Average CPU utilization
- Target value: **30%** (demo purpose)

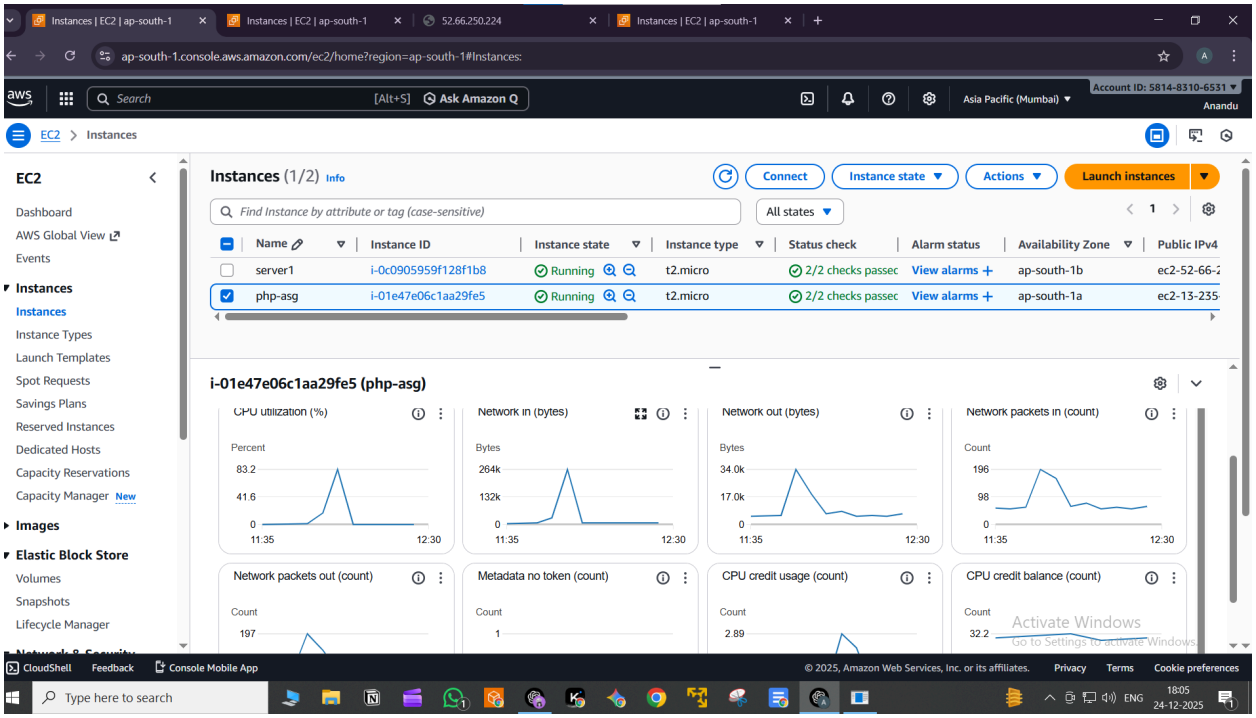
✔ Policy now visible
✔ CloudWatch alarm auto-created

🔥 Load Test

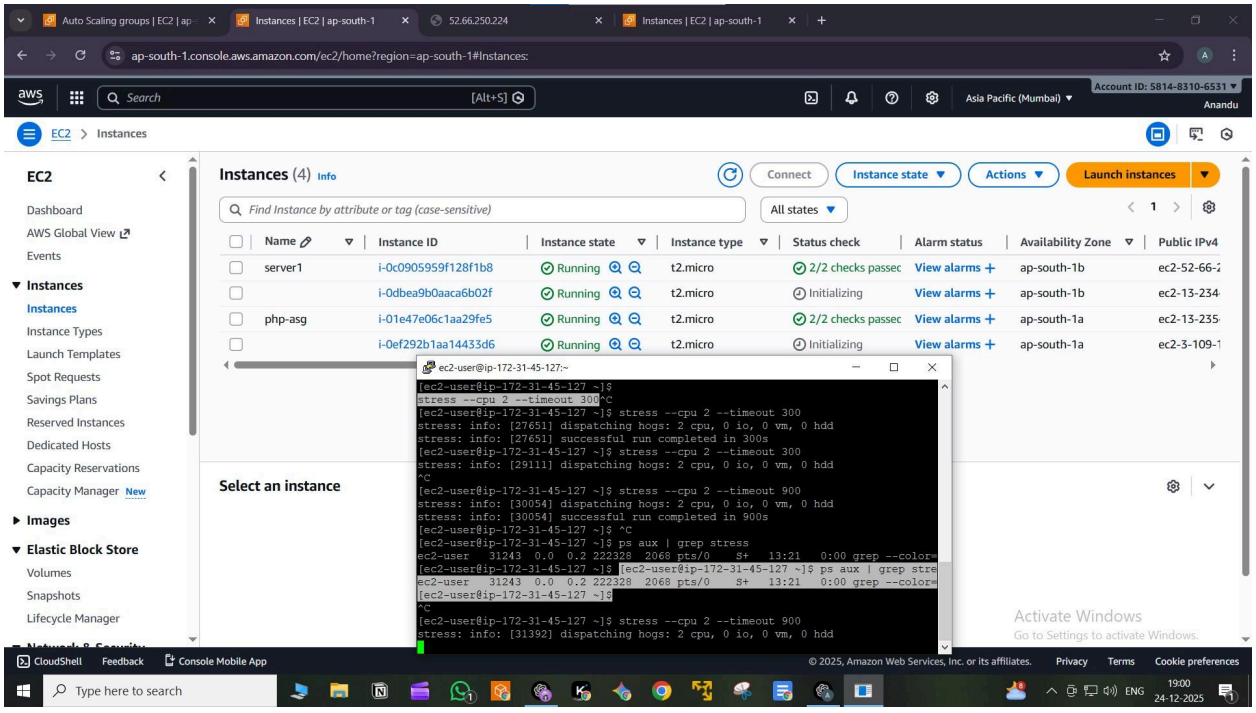
```
stress --cpu 2 --timeout 900
```

Result:

- CPU spikes above target
- ASG launches new EC2
- Target group shows additional healthy instance



✔ Auto Scaling confirmed



🧹 CLEANUP (COST CONTROL)

1️⃣ Auto Scaling Group

- Set Min/Desired/Max = 0
- Delete ASG

2️⃣ Load Balancer

- Delete ALB

3️⃣ Target Group

- Delete target group

4️⃣ EC2 Instances

- Terminate all instances

5️⃣ Launch Template

- Delete **all versions**

6️⃣ CloudWatch

- Verify alarms removed

✔ Zero running resources
✔ Zero ongoing cost

🧠 CONCLUSION

This project demonstrates:

- Load-balanced PHP application deployment
- Auto Scaling using CPU-based target tracking
- Real-world troubleshooting of scaling behavior
- Proper AWS resource cleanup and cost control